

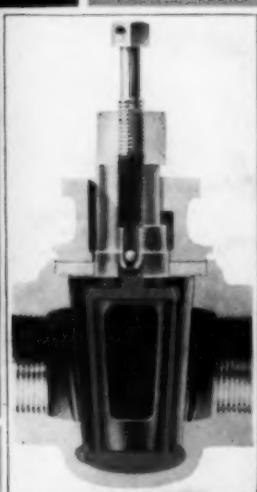
# CHEMICAL & METALLURGICAL ENGINEERING

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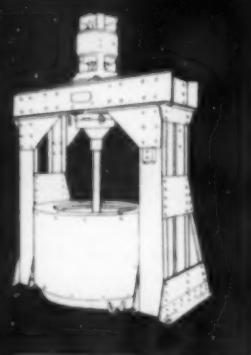
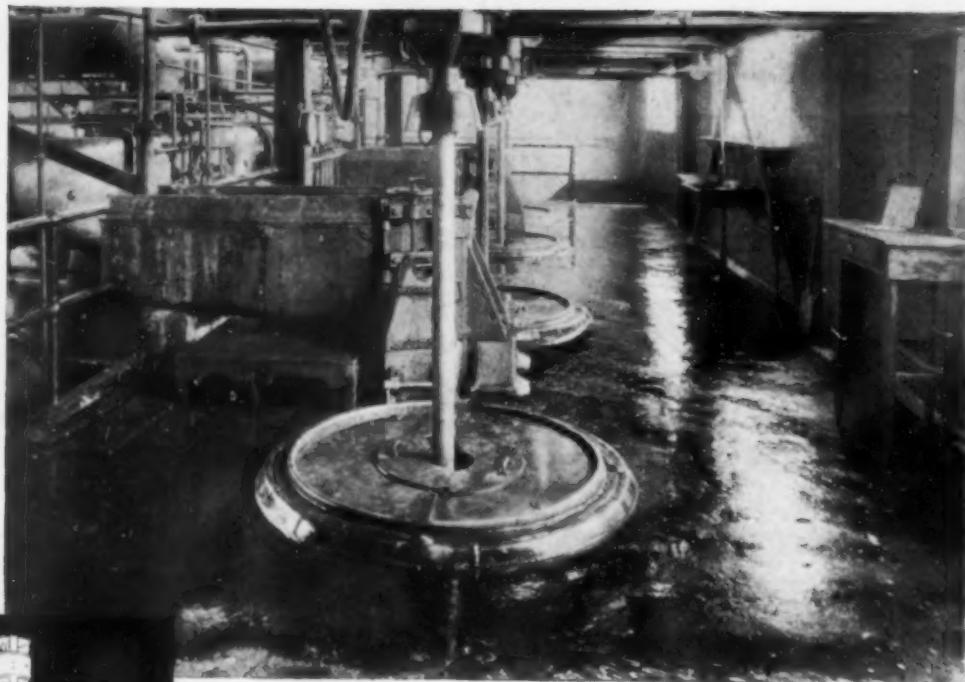
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Number 6

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## An Editorial Forecast

NEXT MONTH the reader of *Chem. & Met.*, who is looking for up-to-date and useful information about unit processes of chemical engineering and their practical application in the Process Industries, will find much that will interest him. A pre-view of the editorial contents of this issue reveals, among other features, the following articles:

**Making High-Temperature, High-Pressure Equipment Safe for Chemical Engineering Operations**  
A staff article on the fundamentals of chemical engineering design and construction, particularly the possibilities of modern technique in welding.

**Industrial Utilization of Agricultural Wastes**  
In the Middle West cornstalks and corn cobs promise to be the raw materials for a wide variety of chemical products. The large scale operations at Danville, Ill., and the work of Professor Sweeney at Iowa State will be described.

**Large-Scale Production of Tungstic Oxide from Wolframite**  
How the Westinghouse Lamp Company has perfected an efficient chemical engineering industry for making and purifying this raw material for filament manufacture.

**Modern Aircraft Finishing**  
Recent tremendous development in aviation finds its reflection in the paint and varnish industry where new methods and materials are being used for finishing airplanes and lighter-than-air craft.

**Comparing Processes for Drying Sulphur**  
A chemical engineering study of various methods and equipment for drying the sulphur now being recovered as a byproduct of gas manufacture on the Pacific Coast.

**Electro-Chemical Production of C. P. Acids**  
C. M. Hoff of the Grasselli Chemical Company shows how chemically pure hydrochloric and nitric acids may be made at less cost by electrical distillation.

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# CHEMICAL & METALLURGICAL ENGINEERING

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## Labor and Personnel Characteristics of German Chemical Industry

A VISITOR to the German chemical industry is impressed not only by its technical aspects but also by some other characteristics that are worthy of thought. One is the relations existing between the companies and their employees. Labor turnover as we know it in the United States is almost unknown. Laborers, clerks, chemists, engineers and executives of all classes remain in the employ of their companies for many years and jubilees are celebrated on the completion of certain terms of service. At one plant over 1,500 employees have celebrated their twenty-fifth anniversaries of service, and many others have completed 30, 35 and 40 years.

WHAT this means to a technical organization relying on scientific knowledge and experience for its success can readily be understood. It gives a background that is denied an organization in which the personnel is constantly shifting and it insures a uniformity in quality and quantity of production that cannot be achieved by inexperienced and untrained crews. In recognition of these facts the constituent companies of the I. G. have long since adopted the policy of providing comfortable housing, clean working conditions, pension funds, medical and hospital service, canteens and dining rooms, vacation and outing resorts, and all the manifold services that contribute to the welfare and contentment of employees.

THE SECOND characteristic that strikes the visitor to I. G. works is the large extent to which technically trained men—chemists and engineers—manage the business of the industry as well as operate its technical processes. The names of Duisberg,

Bosch, Gaus, Greif and others will illustrate the point. One has only to glance over the list of officers and directors of the I. G. to note the predominance of technically trained men. Bankers and lawyers doubtless play their parts in the great organization, but they do not seem to be cast for the leading rôles. Evidently the German chemical industry is run by men who understand it technically as well as financially and economically.

THIS CONDITION is probably a product of long experience and one that may develop in the United States as our chemical industry grows more mature and our technologists grow in business experience. One German criticism of our present system is that we build on dollars rather than on scientific achievement, that we are more interested in an immediate profit than in developing a process and that business men hold the reins of the industry to the exclusion of those versed in science and technology.

FOR THIS reason some Germans believe that their chemical industry is on a sounder basis than ours; but they also believe that in time we shall see the wisdom of greater reliance on men of the highest scientific and technical training, academic and industrial, and bring them into the councils of the industry. From this point of view, at least, some Germans look with great confidence on their own chemical industry and perhaps with some complacence on the American. Not that they lack respect for our ability, but they feel that in their background of scientific and technical experience they have a great advantage which only time and a devotion to science can supply.

## Nitrogen Industry Confronted with New Economic Problems

WITH nitrogen playing such a conspicuously important rôle in the world's economy as well as in the business of the I. G. it is not surprising that Germany took the initiative in calling an international nitrogen conference which was held aboard the *SS. Lützow* on the Adriatic during the first week of May. It was obviously held for the purpose of reaching an amicable understanding among the nations regarding the production and distribution of nitrogen products. Officially it is reported that fifteen nations participated and that when the conference was ended all were in harmonious agreement on the major proposals. It is not revealed, however, what the major proposals were. That the conference was a delightful social event there can be no doubt, for a week on a private yacht on the Adriatic must of necessity be conducive to good fellowship. There was also a program of technical papers on nitrogen economics, fertilizer problems and agricultural experiments, and some important business was probably transacted.

Among the papers read at the conference was a review of the economic situation in nitrogen by Dr. Julius Bueb of the Stickstoff Syndikat, Berlin, which is published, together with interesting graphs, elsewhere in this issue. It shows the leading position which synthetic ammonia and other synthetic nitrogen products have taken compared to other forms, and finally that Germany will produce by synthetic processes almost half the expected world's consumption in the current fertilizer year.

Apparently there is to be no famine in nitrogen, but its present abundance and the prospective increase in world production in the next three years give rise to some problems and speculations. Germany's dominant position in production makes her an avowed advocate of free trade in nitrogen products, for she is producing much more than her agriculture is consuming. Furthermore, her policy of constantly seeking to improve production processes and reduce prices makes her a formidable competitor. Modern synthetic nitrogen works not only require a large initial capital expenditure but involve also a heavy depreciation charge to cover inevitable improvement of the processes. Germany has already incurred these costs to a greater extent than any other nation and consequently feels able to supply a large share of the world's requirements. On the other hand, national independence in nitrogen products is such an attractive goal to other nations that they are spurred on to undertake their own production. The outcome of these conflicting forces and motives cannot be foreseen, but we may be reasonably certain that politics will introduce a new factor that will upset mere economic considerations. In the meantime Germany enjoys the advantage that arises from having actually done on a huge scale the thing with which other nations have merely begun to experiment.

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## Federal Cooperation to Gain Better Industrial Practices

AN INQUIRY by the Federal Trade Commission into the affairs of any industry was generally regarded a few years ago as a meddlesome intrusion to be opposed wherever possible. Now industries are finding that co-operation with the Federal Trade Commission in its "trade practices" studies is not only pleasant but very

much worth while from the standpoint of advancing the best interest of industry itself.

The change in relationship between this important government agency and the industries has come about for two principal reasons. The Commission itself has changed its attitude somewhat as to the purpose to be served by economic industrial investigations. And industries broadly have discovered that those changes in trade practices which result from co-operation in the Commission work are helpful to the honest progressive units in any business because they restrict the dishonest and the shyster groups without placing any handicap upon those who seek honest co-operative relations with their customers.

A recent publication entitled "Trade Practice Conferences," issued by the Federal Trade Commission, summarizes a number of important cases in which the chemical engineering industries should be interested. Among those commodities which have received this attention are edible oils, pyroxylin plastics, rayon, insecticides and disinfectants, and petroleum. However, the industries should not limit their consideration to the trade practices considered for those particular groups which seem most closely related to chemical industry. It is quite as likely that they will find profitable suggestions for better practices in the conferences of the package macaroni industry, or the golf ball conference, or in the discussion of rebuilt typewriters.

Sound principles of merchandising must be woven into the fabric of any industry before it can obtain its greatest opportunity both for service to the public and for enduring profits. Those who guide the advertising and selling of any branch of the chemical engineering industries will do well, therefore, to study the trend in improved trade practice in every line of business.

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## The Silk Purse Problem in Wood Distillation

A WHOLESOME respect for the potentialities of chemical research may preclude literal acceptance of the proverb covering sows' ears as a raw material, but in its broader significance, the adage is still generally applicable. Suitable raw material is obviously a prime requisite for successful production, yet its importance is sometimes overlooked in the shuffle for improved processing.

In the wood distillation industry, for instance, the chemical engineer has little, if any, control over the raw material with which he must work. The selecting and harvesting of the wood is usually carried out by a woods department and outside contractors so that the wood does not come under the chemical engineer's supervision until it reaches the plant. Even then, he frequently has very little influence in the selection and preparation of the material for the carbonizing plant. Variation in species, moisture content, decay, relative proportion of cellulose and lignin, limb and body wood, the ratio of solid wood substance and its specific gravity—all exert their influence on the yield of valuable products, while small, crooked and hollow wood cuts down capacity and production.

Some of the larger plants are awakening to the importance of these factors to their final results. It is safe to predict for them a reward of higher yields as a result of the more careful selection of chemical wood for the pre-drying and carbonizing process and a more compact loading of the charcoal buggies.

## An Almost Tragic Chapter in the Muscle Shoals Serial

WITH FLAGRANT disregard for every responsibility to good government and sound business practice, the first session of the 70th Congress closed with a disgusting exhibition of political chicanery. With partisan politics dominating every legislative consideration, it was only natural that another hectic—almost tragic—chapter should be added to the long continued story of Muscle Shoals. That a rapidly advancing air-nitrogen industry or an investment of \$325,000,000 in American fertilizer manufacture should be sacrificed under the guise of "cheap fertilizer for the farmer" apparently meant little to those whose thoughts were in terms of presidential possibilities and November elections.

From the time the Senate passed the Norris resolution on March 13 until President Coolidge's "pocket veto" on June 7 put an end to its spectacular career, the Muscle Shoals bill had run the entire gamut of unsound and uneconomic legislative proposals. Government ownership and operation, subsidized competition, paternalistic monopoly, price fixing and patent pirating are a few of the nostrums that would have been foisted upon the chemical industry at various stages of this legislation. The original Norris resolution provided for experimental production of concentrated fertilizers and gave the Secretary of Agriculture the authority to sell these products only when "found commercially feasible." In the main, the measure would not have been highly objectionable to industry, assuming, of course, its prudent administration.

WHEN this bill reached the House, however, Chairman Morin of the Committee on Military Affairs, succeeded in substituting a radically different bill of his own making. This provided for Government operation of Muscle Shoals as well as the manufacture and sale not only of complete fertilizers but also of a wide range by byproducts and fertilizer materials that might have included every nitrogen, potash and phosphoric acid derivative. It was significant of the temper of the Congress, worn weary with wrangling and the trading and log-rolling for farm relief, flood control and Boulder Dam, that no hearings were held on the Morin substitute. The Committee stamp of approval appeared likely to ensure its passage in spite of its radical proposals for carrying the Government so far into the field of private enterprise. Here the National Fertilizer Association entered on the scene and voiced a unique and highly effective protest in the form of "open opposition, openly presented." Instead of leaving the case to be presented by paid agents and professional lobbyists, the manufacturers themselves came to Washington in person and directed an aggressive campaign of newspaper and direct-by-mail advertising.

The first result was that the Morin bill was amended by eliminating the provision for the manufacture and sale of complete fertilizers. Then, at the instance of Representative McMillan of South Carolina, the words "fixed nitrogen" were carefully substituted for "complete fertilizer" throughout the entire bill. While the Government was thus taken out of the fertilizer industry, the change was obviously at the expense of plunging the Government squarely into the fixed nitrogen business. The sponsors claimed, however, that the bill more nearly

conformed to the National Defense Act of 1916 and it was, therefore, passed by the House by a vote of 251 to 165.

The conferees met hastily in a special Sunday session to patch up the differences between the Norris resolution of the Senate and the "fixed nitrogen" bill of the House. Then, for reasons which only Congressmen can understand, the conferees arrived at the surprising decision to re-insert the complete fertilizer provisions and in addition to provide for construction of the Cove Creek Dam 300 miles upstream from Muscle Shoals. Immediately violent opposition in the Senate to both provisions sent the bill back to the conferees where the complete fertilizer feature was again removed. In its place there was given authority for making fertilizers for experimental purposes and for the commercial production of fixed nitrogen "by the use of existing facilities or by modernizing them, or by the use of any process." The Muscle Shoals Corporation, which the bill created, was given access to the United States Patent Office "for the purpose of studying, ascertaining and copying all methods, formulae and scientific information necessary to enable the corporation to employ the most efficacious and economic process for the production of fixed nitrogen." Any individual or firm whose patents were thus pirated was given the questionable privilege of suing for compensation in an appropriate federal court.

In spite of these and other equally objectionable and communistic features, the measure was passed on May 25 by both the Senate and the House. Fortunately, for industry and the entire country as well, President Coolidge was not to be swayed from his consistent stand against Government conduct of private business. Decision to withhold his signature was made after careful consideration of the measure itself and of the arguments made against it by the chemical and fertilizer industries.

From the standpoint of the American air-nitrogen industry, the danger threatened by such legislation is largely psychological. Competition from a Government-operated plant at Muscle Shoals, even if highly subsidized, is not especially feared by the leaders of the domestic industry. They appreciate the fact that it would take several years to build an adequate technical organization and that then new processes and finally new plants would be required to replace the ones at Muscle Shoals. By that time private enterprise will have created adequate fertilizer nitrogen capacity and it is reasonable to suppose that private costs will be lower than those of the Government. The Muscle Shoals Corporation, if Congress would have the patience to provide for its existence over such a profitless period of development, would likely find itself in the embarrassing position of having costs actually higher than the selling price asked by private enterprise (including, of course, a fair profit).

REAL danger lies not in the prospective competition but in the false hopes aroused and the incorrect impression given of the progress being made by the domestic air-nitrogen industry. Nothing will hinder it more in its sincere effort to produce as quickly as possible what the farmer really wants, namely, concentrated fertilizers at rock-bottom prices. The froth of political effervescence stirred up by the agitation for cheap fertilizer is not only penalizing the industry at the expense of the farmer, but is preventing a dispassionate, constructive solution of the Government's highly complicated problem at Muscle Shoals as well.

## Golf, Chemistry and the Institute

RUMOR has it that Evanston, Illinois, will be invaded by an army of enthusiastic divot hunters on July 23 or thereabouts. For four weeks thereafter rejuvenated chemists, chemical engineers and industrialists will divide their time in proportions determined by their natural inclinations between pursuit of the illusive bogey (or even par), Lake Michigan and up-to-the-minute bread-and-butter information on what's new in chemistry and its chemical engineering applications.

This second session of the Institute of Chemistry of the American Chemical Society will need no introduction to those who were fortunate enough to attend the Penn State session in 1927. For those who did not, the Institute again promises a type of learning that is recreation and recreation that is—whatever you choose to make of it.

## Making Organic Synthetics to Performance Specifications

INDUSTRIAL ORGANIC synthesis has reached such an advanced stage that the user of chemicals can frequently have his needed material made to performance specifications. If we want a solvent of a given boiling point with definite solubility relations, resistant to heating, to chemical attack, or to other reaction under named conditions, we can now set up these specifications in a purchase order and very frequently can have our needs met completely by new products.

In the college teaching of organic chemistry, the student learns how the properties of materials change progressively with change in length of the carbon chain of the mother compound. The student also learns how the introduction of various modifying radicals or substitution groups forming amino, nitro, or sulphonic derivatives changes the properties of the resulting chemical. This knowledge which was formerly largely of academic significance has been made of a very tangible industrial use. Just recently one big chemical company was asked if any of its products met with certain specifications. Its first consideration of the inquiry showed that no one of its then available compounds would comply with the desired properties, but a knowledge of the effect of substitution of radicals indicated that a slight modification of one of its regular products could be made with the likelihood of conforming to the desired specification. Actual trial of this modified compound demonstrated that the forecast was correct and the industrial need has since been met with entire satisfaction on a large scale.

Such service need not be confined to the chemical industries. There appears to be one important opportunity for great service on the part of the synthetic organic manufacturers in the making of a boiler medium. When using water a boiler and engine system attains its maximum commercial efficiency even with the most modern equipment when delivering about twenty per cent of the energy from the coal as electricity on the plant bus bar. It has been commercially demonstrated by the work at Hartford, Connecticut, that with mercury a considerably higher overall energy efficiency can be attained. But it is obvious to every one that there is not enough mercury in the world to serve as a boiler medium for all power units; even if its efficiency should be demonstrated to be almost

theoretically perfect, its usefulness is limited. Hence there has been much interest in the use of diphenyl oxide as a boiler medium, and more recently still in diphenyl itself, which apparently has certain inherent advantages over the oxide.

It would seem that there must be available some still better boiler medium which can be made in the almost unlimited quantity which the requirements for power plants would seem to make necessary. It is not practical at the moment to draw specifications for such ideal boiler medium; this is a task remaining for the mechanical and chemical engineers to work upon. But it is evident that such compound to be ideal should have the correct thermodynamic properties to permit maximum operating efficiency; it should be stable and non-corrosive; it should be non-toxic; it should be cheap; and it should meet a dozen other requirements, some of which are now known while others await further study.

The important point for users as well as producers of organic chemicals to consider is that we are now at the beginning of a new era in industrial synthesis. We can now for the first time take full advantage of our knowledge of the relation of structural composition to behavior of compounds. It is important that all branches of industry appreciate this rapidly increasing fund of knowledge in order that we may make and use compounds as nearly as possible ideally suited to their tasks.

## Colloidal Silica Stands Accused

PREVALENCE of tuberculosis has long been known to be a concomitant to certain kinds of dusty industrial operations. While the remedy is recognized—use of effective respirators—everyone knows how unpleasant it is to work in one of these hog-snouted protectors; and how easy to forget it, with the remark, "What's a little dust, anyway?" And so it has gone on, here a victim, there a victim, with general opinion saying, if it bothered to notice the case at all, that lung tissue abrasion seems to have caused the passing of another good man.

But does abrasion open a way for tuberculosis? Research conducted by the United States Public Health Service, and discussed recently before the Chemical Section of the National Safety Council by Dr. A. E. Russell, assistant surgeon of the Service, seemed to indicate that the action of the particles was not one of mechanical attrition. It was found that dust free from silica was not harmful as such, nor were silicates conducive to pulmonary disease. Abrasive action gives way in the new theory to chemical. It is now suspected that the hazard of any dust varies as the quantity of free silica and that it is this component of the dust that, acted upon in the lung tissue, forms a colloidal silica of high toxicity. In other words, tubercular silicosis results from an active lung poison rather than from minute tissue abrasions.

While this may easily be the true explanation of the disease, we are as yet no better situated to combat it. We may be certain that with this starting point, medical science will do its best to counteract the action of the poison. As always, however, prevention improves upon the cure, and it is in prevention that the dust-producing industries can carry forward the already extensive programs of dust elimination and removal.

## Measuring Nitrogen Trends With Inadequate Statistics

TWO RECENT BRITISH estimates regarding trends in nitrogen fixation have led to quite diverse and wholly conflicting conclusions. The facts cited in each case were correct—that is, as far as they went. But by using only limited information the conclusions drawn in connection with each group of facts were partially in error.

Discussing the relation of power costs to trends in nitrogen fixation, Sir Alexander Gibb, President of the Institution of Chemical Engineers pointed out why the direct synthetic process for ammonia production had advanced so rapidly in the period from 1913 to 1926. He stated, and correctly, that this process, for which there was one plant in 1913, furnished the basis for operation of 39 plants in 1926, producing about 75 times as much ammonia in that year than was produced 13 years before. The percentage of world production of fixed nitrogen obtained from the direct synthetic process was 11 per cent in 1913 and over 70 per cent in 1926 according to Gibb's figures as quoted by the Bureau of Foreign and Domestic Commerce. From these facts some have inferred that the direct synthetic process is replacing all other processes, a conclusion which is wholly unwarranted.

In the last annual report of the British Sulphate of Ammonia Federation, figures are given for the production of synthetic ammonia by the direct process and for the cyanamide process of nitrogen fixation, as well as for byproduct ammonia production. These data show that there was a 53 per cent increase in direct synthetic ammonia production between the fertilizer year 1923-24 and the fertilizer year 1926-27. During this same period there was a 73 per cent increase in fixation of nitrogen by the cyanamide process. Hence it may be concluded by some that the cyanamide process is advancing faster than the direct synthetic process, if one judges by the trends of the past four years rather than by the trend of the fourteen years past.

Both of the sets of data quoted are reliable and probably substantially correct. The proper conclusion can only be inferred if one regards both sets of data and weights them appropriately. Apparently the right conclusion is three-fold:—First, synthetic nitrogen production has increased during recent years very largely by all processes. Second, the greatest increase in production, measured both in tonnage and in percentage of former production, has occurred in the case of the direct synthetic process. Third, fixation of nitrogen by the cyanamide process has steadily increased, in fact by a larger percentage during the last few years than any other process; and this is true despite the claims made by some that the cyanamide process is obsolete and no longer a factor in nitrogen fixation.

Aside from the obvious moral—do not draw your conclusions from half-truths—there is an important generalization for the encouragement of chemical engineers and chemical engineering industries. We may safely infer that industry is not dependent upon any one scheme or one single group of processes for maintenance of adequate inorganic nitrogen supplies for the world. Chemical engineering technology has established commercially successful processes of several sorts and one must carefully judge the particular local economic conditions, including cost of power and raw materials,

before one decides which is the better source of fixed nitrogen for the particular area. To assume that any one system is doing away with development by all other processes is a fallacious conclusion.

## A New Incentive for the Inventor?

DOES obviousness preclude patentability? A recent decision of Chief Justice Martin, Court of Appeals of the District of Columbia, in reversing the Patent Office's refusal of claims in connection with a frozen confection seems to deny this possibility.

In brief, the appeal was as follows: Harry B. Burt made application for a patent covering the freezing of a stick into a block of ice cream. The Patent examiners refused the claims on the ground that it required no invention to combine the stick of a lollipop and the ice cream of an Eskimo Pie, both of which represented prior art. The Chief Justice concluded his reversal of the Patent Office's decision with the remarks that, "It is quite easy now that . . . (the applicant) has solved the problem (of combining a stick and ice cream) to reach the conclusion that it was very simple of solution, but the patent law contemplates rewarding the one who really solves it and not the one who, after its solution, thinks he could have solved it. The decision is reversed."

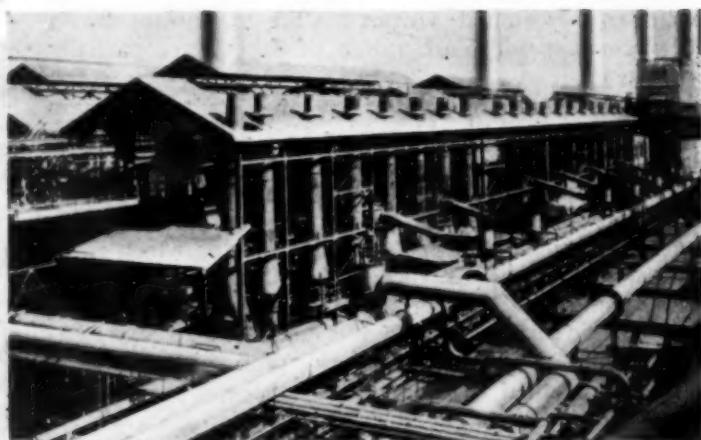
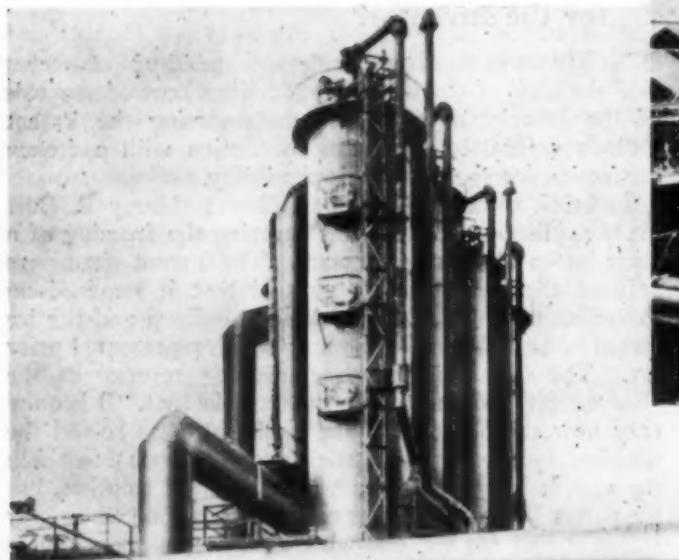
In other words, simplicity is no bar to patent protection. Novelty and usefulness are the criteria. The Court appears to have established a precedent for a liberal definition of "invention" which, it may be expected, will put an effective brake upon the old Patent Office principle of rejection of claims for lack of "invention" over previous ideas.

## Further Advances in Chemical Ingenuity

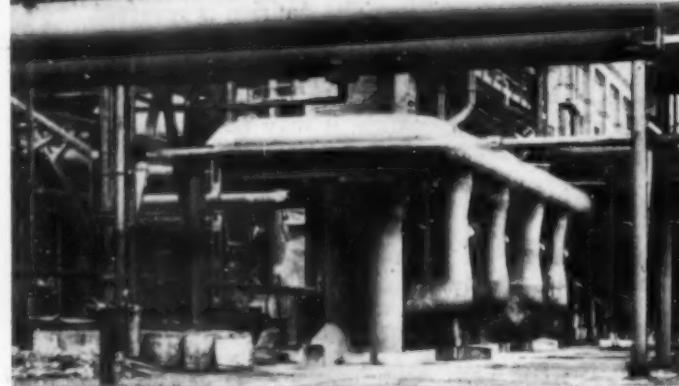
THESE days of accurate technical control are all too unproductive of good chemical yarns. With the virtual extinction of the cracker barrel, we must needs fall back upon what Pat said to Mike, what happened in the Pullman car or the adventures of the amorous drummer. We therefore sigh with editorial relief in recounting a tale for which our gratitide is due to our youthful contemporary, "Dorrco Doings."

It is told that there was once a certain isolated chemical plant where hydrogen-ion indicators were unknown. An operation called for the feeding of an acid and an alkaline liquor into a tank in proportions to yield neutrality within close limits. The operator, instead of tearing his hair in an embarrassment of ignorance, induced a number of ducks to make their headquarters on the liquor surface. While the ducks showed reasonable contentment all was well, for the solution was neutral. When they became restless only quick action could save the situation, for the birds took flight immediately if the batch became too acid or too alkaline for comfort. In that event, the only recourse was to cease operations until the ducks returned. One wonders, though, how it was possible to tell on which side of neutrality the solution erred. It is a pity that the famous Mr. Goldberg had not bent his ingenuity to harnessing the ducks for automatic control. A few levers, pulleys, weights, mouse traps and canary birds might have saved many a disastrous shut-down.

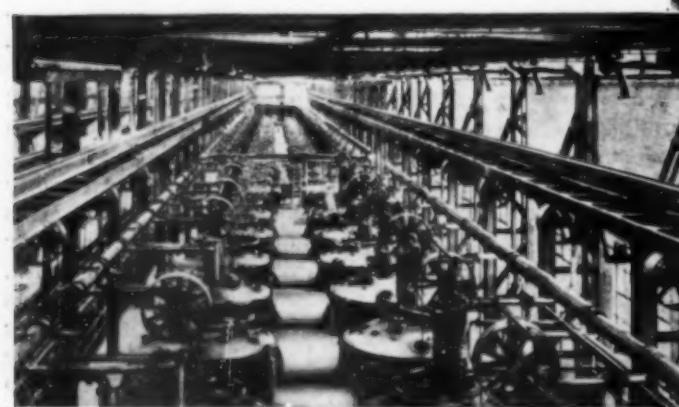
# Editorial Impressions of Economic and



Section of the gas plant where producer gas is made from brown coal as a source of nitrogen and where water gas is produced from coke to supply the hydrogen for the ammonia synthesis.



Absorption towers used in the preliminary purification of the gases prior to the ammonia conversion. Carbon dioxide, residual carbon monoxide and hydrogen sulphide are removed in separate operations.



An impressive row of crystallizers in the ammonium sulphate plant. During the coming fertilizer year 550,000 net tons of nitrogen will be produced in this one plant.

*Views in the great  
Leunawerke of the I.G.  
at Merseburg*

Converters in which the carbon monoxide is oxidized to dioxide by passing the gas mixture with steam over masses of iron oxide giving an enrichment in hydrogen.

# Technical Progress in German Chemical Industry

By H. C. Parmelee

**I**T IS SIGNIFICANT of the importance of chemistry in the economic and industrial life of Germany that the chemical industry of that country is in a thriving and prosperous condition. Apparently no other industry is sharing more fully in the general economic improvement of the country. This is reflected in the annual report for 1927 of the I. G. Farbenindustrie A. G., which held its third general meeting at Frankfort on May 24. The financial statement showed a net profit of 100,812,133 marks (approximately \$25,000,000), and a dividend of 12 per cent on the outstanding shares was announced.

The ramifications of the I. G., which were shown graphically in *Chem. & Met.* last January, extend into every phase of the chemical industry except the production of potash, and consequently a prosperous I. G. is synonymous with a prosperous German chemical industry. In its annual report improvement was noted in all its principal activities. The dye business is increasing in spite of sharper competition in the world market. Particular attention is being given to the production of specialities that permit of new applications, and research is constantly being directed toward the discovery of new and improved dyestuffs. In inorganic chemicals and organic intermediates both domestic and export markets have improved. The rapid development of the aircraft and automotive industries is increasing the demand for magnesium alloys, and a new factory is being built for their production. Nitrocellulose lacquers are gaining in popularity and the manufacture of solvents is expanding. New pharmaceuticals have been added to the already

impressive list. A full line of photographic chemicals and products is being made and an arrangement has been consummated with Ansco Photoprodcts Inc. to market them in the United States. The world wide demand for rayon has stimulated the growth of that industry in Germany as in other countries, and will lead to further expansion of production. Finally mention is made of improvements in the manufacture of cellophane and of progress in the production of other related products.

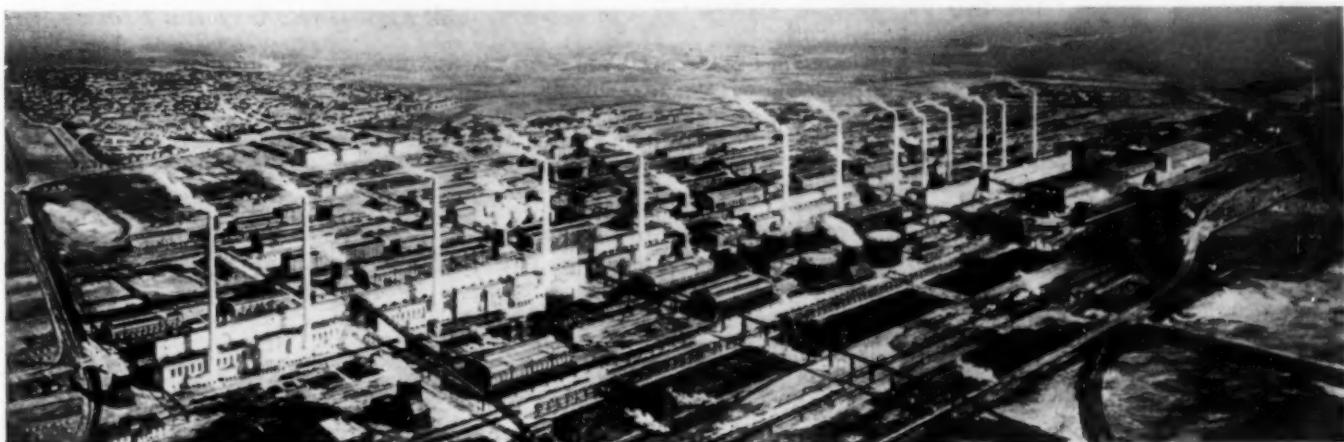
#### Nitrogen Industry Most Impressive of the Activities of the I. G.

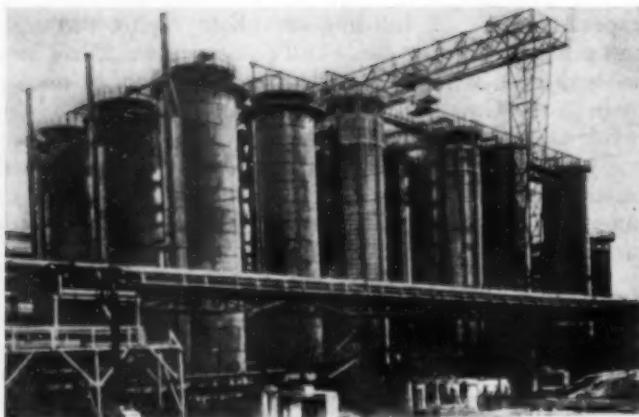
THESE items which were considered worthy of mention in the annual report give only an incomplete picture of the industries in which the I. G. is doing a profitable business, but they will serve to show the variety of interests that are combined in this great organization. There remains, however, the great nitrogen industry which, in its novel technology and the magnitude of its production, is easily the most impressive single activity of the cartel. For when the nitrogen-fixation plants at Oppau and Merseburg are completed according to plans already laid down they will have an annual capacity during the fertilizer year of 1928-29 of 700,000 tons of nitrogen—about 150,000 tons at Oppau and 550,000 at Merseburg. This production will require the nitrogen contained in about 770 million cubic meters of air.

The historical development of this huge industry is interesting. It was in 1908 that Professor Haber took out his first patents on the synthesis of ammonia, using osmium or uranium as catalysts. In 1909 the Badische Anilin & Soda Fabrik began its development of Haber's experiments under the direction of Dr. Carl Bosch, and in three years had the process in commercial operation. Numerous tests were made to discover a less expensive and more plentiful contact substance than osmium or uranium, resulting in the development of the present iron catalyst. In the meantime new apparatus and equipment had to be designed and constructed for the compression and treatment of the gases at high temperatures. The first liquid ammonia was produced in July, 1910. In 1911 the output was increased first to 25 kg. and later to 100 kg. per day, and in 1912 it reached 1,000 kg. of pure ammonia daily.

This work, which had been done in the Badische plant at Ludwigshafen, led to the erection of the Oppau works nearby which were brought into production in 1913 with an initial capacity of 30 tons of ammonia per day. The so-called Leunawerke at Merseburg were begun in 1917

More Than a Mile of Boiler Houses at Merseburg: the Largest Steam Generating Station in the World





Absorption Towers in Nitric Acid Plant at Oppau



Storage of Synthetic Fertilizer Salts at Oppau

and have since been developed into the largest nitrogen-fixation plant in the world. Both works use the same technical process for fixing nitrogen as ammonia, but they differ in their methods of power production and in their fertilizer products.

At Oppau gas engines are the principal prime movers. The Merseburg works, on the other hand, being located adjacent to extensive deposits of brown coal that is cheaply mined and delivered to boiler-house bunkers, use steam power. The boiler houses, seven in number, extend for an unbroken line for over one mile and constitute the largest steam-generating station in the world. Coke is used at both plants for making water gas. The nitrogen products at Merseburg are ammonia water and ammonium sulphate only. At Oppau there is also an ammonia oxidation plant, and a greater variety of fertilizers is made—ammonium sulphate, chloride and phosphate, urea, and calcium, sodium, potassium and ammonium nitrates.

#### Catalytic Process for Cheap Production of Hydrogen

**C**HEAP hydrogen is the crux of synthetic ammonia production and an ingenious catalytic process, in which coal plays an intermediate part, has been developed for its production from water. By the combustion of coal in producers a gas rich in nitrogen is obtained. Water gas, on the other hand, yields a complement of gas rich in hydrogen. Both gases contain carbon monoxide, and by passing them together with steam through catalytic masses of iron oxide the steam is decomposed, further enriching the gas mixture in hydrogen and oxidizing the carbon monoxide to dioxide. In this manner a mixture of nitrogen and hydrogen is obtained which, when purified, contains the two elements in approximately correct proportions for ammonia synthesis. A small Linde air liquefaction plant furnishes a limited quantity of liquid nitrogen used to adjust the exact proportions of nitrogen and hydrogen in the final gas mixture.

The purification of the gases involves the removal of hydrogen sulphide, the extraction and recovery of carbon dioxide, and the elimination of a small residue of unconverted carbon monoxide. Hydrogen sulphide is removed by passing the gas mixture through activated carbon where elemental sulphur is deposited. This is removed periodically by solution with ammonium sulphide and recovered as pure sulphur. Carbon dioxide is separated from the gas mixture by washing with water after compression to 25 atmospheres. The gas thus removed is

subsequently recovered for use in making ammonium sulphate by the gypsum process, and for the manufacture of urea by combination with ammonia. Finally the gas mixture is compressed to 200 atmospheres and treated with ammoniacal copper solution which dissolves the residue of carbon monoxide. The purified mixture of hydrogen and nitrogen is then ready for ammonia synthesis by contact with the catalyst at a temperature of about 600 deg. C. The exit gases exchange heat with the ingoing gases and pass to the absorption system where they are dissolved in water and recovered as a 25-30 per cent ammonia solution. The residue of unconverted hydrogen and nitrogen again passes through the cycle with fresh gas to replace that converted into ammonia.

The end product is thus a 25-30 per cent ammonia solution in which form it is either stored in large tanks or shipped to other works for various technical uses. The great bulk of it, of course, is converted into fertilizer salts.

Fertilizer manufacture in Germany under the direction of the I. G. has developed into a chemical industry of the first magnitude, based on fundamental principles of science and engineering. A new technology has been developed that is unlike anything the fertilizer industry has known before. The products are almost chemically pure plant foods in concentrated form that can be mixed in suitable proportions to meet the needs of various soils and crops, and from their initial manufacture to their experimental application the whole business is conducted with scientific care and accuracy. In its manufacturing aspects particularly the industry offers marked contrast to the empirical methods that have hitherto characterized the fertilizer business.

#### Ammonium Sulphate Produced by Means of the Gypsum Process

**S**YNTHETIC ammonia is the base material from which fertilizer manufacture proceeds. Carbonic acid plays an important part in some of the processes, and gypsum, salt and limestone comprise the other principal raw materials.

Ammonium sulphate is the principal product in point of tonnage. The customary method of combining directly ammonia and sulphuric acid has been abandoned because Germany has no sulphur resources and consequently could not produce sulphuric acid cheaply enough for fertilizer manufacture. As a substitute an ingenious method has been developed which at once makes the industry independent of Spanish pyrites or other sources of sulphur and uses a domestic product, gypsum, of which

there is an abundant supply. This is finely ground, mixed with water and treated with ammonia and carbon dioxide gases. A double decomposition ensues between ammonium carbonate and calcium sulphate, yielding ammonium sulphate in solution which is then filtered from the calcium carbonate and evaporated. The carbon dioxide used at this point is that derived from the catalytic production of hydrogen from coal and water gas. It serves in a similar manner for the production of ammonium chloride from salt, the process being like that just described for ammonium sulphate. A double decomposition takes place between ammonium carbonate and sodium chloride, yielding ammonium chloride and sodium carbonate. In this case both end products are recovered. The method is similar to that long known in the ammonia-soda process where, however, the goal is the production of soda and the ammonia is regenerated by treatment with lime.

Carbon dioxide plays a further important rôle in the manufacture of urea, the other raw material being ammonia. The two gases are separately liquefied and combined under pressure and heat with the resultant splitting off of water and the conversion of part of the mixture into urea. This is separated from the uncombined gases at the end of the process at atmospheric pressure. The gases are again compressed and introduced into the system with fresh supplies, and the solution of urea is evaporated and spray-dried in a current of air.

A fourth fertilizer salt containing ammonia nitrogen is ammonium phosphate, made by the direct combination of ammonia and phosphoric acid. The latter is obtained as a water solution in the treatment of phosphate rock with sulphuric acid, separated from the precipitated calcium sulphate and evaporated. This salt is used largely as a constituent of the complete fertilizers containing nitrogen, phosphoric acid and potash, which are rapidly gaining favor in Germany.

By a third catalytic process (the first being in the generation of hydrogen and the second in the synthesis of ammonia) the Oppau works produces nitric acid from



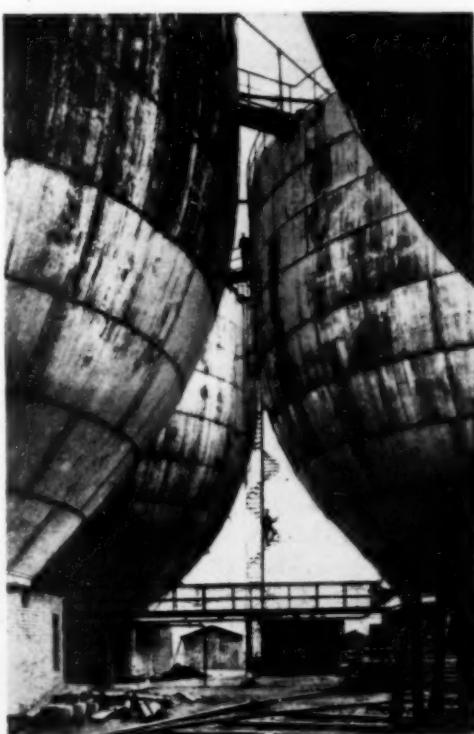
Chemical Engineering Laboratory in the Ammonia Plant at Oppau

ammonia for the manufacture of nitrates of calcium, sodium, potassium and ammonium. The process is carried out in large converters in which the mixture of ammonia and air passes downward through the glowing contact mass. The resulting nitrogen oxide gases are absorbed in water in large granite towers, forming a 50-per cent nitric acid. This absorption is incomplete, however, and the residue is recovered in steel towers sprayed with soda solution which is evaporated for the production of sodium nitrate. Having once obtained nitric acid the production of the other nitrate fertilizers—calcium, potassium and ammonium—is readily accomplished.

Calcium nitrate is being produced in increasingly large quantities in Germany, finding favor in those localities which require an addition of lime to the soil. It is manufactured by passing nitric acid over limestone in towers, completely neutralizing the resulting solution, filtering and evaporating. The concentrated liquid is sprayed with cold air into a large chamber in which the solid salt falls in fine crystalline masses. On account of its hygroscopic character it is stored in closed silos and packed for shipment in water-proof bags of special construction.

#### *Agricultural Tests with Complete and Concentrated Fertilizers*

THIS brief survey of fertilizer manufacture in Germany is sufficient to show the novelty and variety of the chemical operations. The magnitude of the industry is measured by the fact that in the fertilizer year 1928-29 about  $3\frac{1}{2}$  million tons of fertilizer salts of all kinds will be made. But the I. G. does not stop with the manufacture of fertilizers: it extends its interest to their experimental application, and for this purpose maintains at Limburgerhof near Oppau an agricultural experiment station. Here scientific studies are made on the effect of various fertilizers on different soils and crops to determine the most favorable conditions for large yields of plant foodstuffs. Tests are made first in pots, second in 1-sq.m. plots, third in small field areas and finally on large farms. The practical results of interest to German agriculture are published in a monthly magazine distributed free to farmers and other interested persons. A score of offices for advice and consultation are maintained in different parts of Germany, and every effort is made not only to ascertain the practical requirements of the farmer but also to transmit to him the results of scientific experimentation. In this respect the I. G. is following the traditional methods of its dye business, fully realizing that success in synthetic fertilizer manufacture must rest finally on the degree to which the products meet the needs of agriculture.



Spherical Holders for Ammonia Liquor  
At Merseburg each holder has a capacity of 5,000 cubic meters

# Chemical Engineering at Iowa State

An interview with one of the dynamic personalities of the profession and an insight into his methods and educational philosophy

*By S. D. Kirkpatrick*

*Associate Editor, Chem. & Met.*

IT HAS BEEN SAID many times that a business institution is but the elongated shadow of the man at its head. Perhaps the same figure of speech has also been applied to an educational institution, but its application seems peculiarly appropriate in the case of the chemical engineering department at Iowa State College. There the vigorous, vibrant personality of O. R. Sweeney finds its reflection in an educational philosophy that is unique in chemical engineering.

A recent visit to Ames afforded an opportunity to discuss the chemical engineering course, to inspect the splendid new chemical engineering building and laboratory and, most important, to spend a few hours with the remarkable man at its head. This article is a summary of the impressions gained at that time, supplemented by notes and correspondence with Dr. Sweeney and his associates.

W. K. Lewis recently remarked that education, reduced to its fundamentals, is a matter of contact of personalities—and not a matter of organization or mechanical facilities. To teach chemical engineering the way it should be taught, he holds that a man must have something more than superior technical ability, extended practical experience, and unusual breadth of vision. He must have faith in his job, an enthusiasm for his chosen work, and with this he must have an optimistic, resourceful and appealing personality to arouse and hold the interest and respect, if not admiration and love, of his students.

Professor Sweeney measures close to these ideals. Forty-five years of age, B.S. in chemical engineer-



O. R. Sweeney  
Head of the Chemical Engineering  
Department at Ames.

ing from Ohio State, Ph.D. from the University of Pennsylvania, and some post-graduate work at Göttingen, represent his academic training. Two years of teaching at Ohio State University, followed by six at Pennsylvania, one at Fargo, N. D., and three as head of the department of chemical engineering at Cincinnati, are the formal statistics of his prior teaching experience. These in themselves are not unusual, but become so when combined, first, with eight years as a practical worker in the iron and steel industry from which Professor Sweeney graduated, in his own words, "a better sheet steel worker than a Ph.D." This practical operating experience was followed by an executive position with one of the steel companies. The war found Professor Sweeney as a Major in the Chemical Warfare Service where he was assigned to the problem of designing, superintending construction and finally operating the chlorpicrin plant at Edgewood—the largest poison-gas plant built in this country. There were other assignments, too, and since the war he has had sustained consulting practice through close contact with Iowan industries and with firms of national importance. During the eight years at Iowa State the research work under Professor Sweeney and his associates on the utilization of agricultural wastes has attracted international attention.

So much for the technical qualifications of the teacher. His philosophy of teaching can best be seen in the course he teaches.

IT IS CHARACTERISTIC of Professor Sweeney that his course should not follow the average of the 65 or more schools in this country that profess to give courses in chemical engineering. "Too many so-called chemical-engineering courses," he declares, "are nothing but courses in chemical technology with a little mechanical



A Side View of the New Chemical Engineering Building at Iowa State College

and electrical engineering thrown in but primarily dominated by the chemistry departments. The schools that have real courses in chemical engineering are in the minority." A comparison of the course at Iowa State with the average of the 65 colleges and with the average of 32 courses studied in detail by the Committee on Chemical Engineering Education of the American Institute of Chemical Engineers, reveals some interesting points of divergence.

**Percentage Composition of Chemical Engineering Courses**

Subject	Iowa State College	A.I. of C.E. Committee's Average of 32 Courses	Average of 65 College and University Courses
Cultural.	6.1	11.7	13.9
Mathematics	13.6	10.7	11.2
Physics	7.0	7.7	7.5
Mechanics	5.6	5.7	5.3
Chemistry	25.3	29.2	30.0
Chemical Engineering	20.1	11.0	10.3
Other Engineering	17.3	18.7	16.0
Other Science	1.8	1.1	2.1
Electives	2.8	4.2	3.7

It is very apparent that the Iowa State course has an intensely practical slant. The proportion given to cultural subjects is but half the average, while the proportion for chemical engineering has been almost doubled. The cultural courses consist entirely of 13 credit hours (39 clock hours) of English which Professor Sweeney regards as so basically important that he does not allow the emphasis to end here. Every piece of work in chemical engineering requires written reports which are

corrected and graded from the standpoint of English as well as factual content. What the student misses in the way of other cultural courses is made up to some extent by the work of a committee in the engineering college, whose duty is to raise the cultural standards of the students through extra-curriculum lecture courses and other opportunities for cultural work. Absence of any foreign language requirement is an unusual feature of this chemical engineering course.

The slight to chemistry implied in the figures in the table is more apparent than real. In all 54 credit hours are provided, divided as follows: Elementary, general and qualitative analysis, 12 hours; analytical chemistry, 15 hours; physical chemistry including electro-chemistry, 12 hours, and organic chemistry, 15 hours. All of this work is given in the Department of Chemistry which at Iowa State is quite distinct from the Department of Chemical Engineering.

The courses classed under the head of chemical engineering are: Industrial stoichiometry, thermodynamics, chemical machinery and equipment, large-scale processes, chemical cost accounting, industrial chemistry of large-scale chemical processes, and design, layout and construction of chemical plants. A course is given in the testing of engineering materials but this is not analytical chem-

istry. It is interesting to observe that all industrial chemistry is taught in the chemical engineering department, since the two are considered inseparable in practice. Although 43 credit hours of work are required in the chemical engineering department, the majority of students take 4 to 6 hours of electives in chemical engineering.

The chemical engineering student is required to work a minimum of 170 hours during one summer in a large industrial plant. This requirement was made, of course, to give the student the "feel" of plant operation and a chance to observe the practical application of what he has been studying in theory and small-scale production. The spirit of optimism and practical achievement is further encouraged in the student by the assignment of a problem of practical significance that the student can readily appreciate. The work on the chemical utilization of corn cobs or the other agricultural wastes has been taken up enthusiastically by students who have immediately seen its practical value. Close contact is kept not only with the industries of the state but through successful alumni with industries in other parts of the country. The latter are asked to come back to Ames periodically

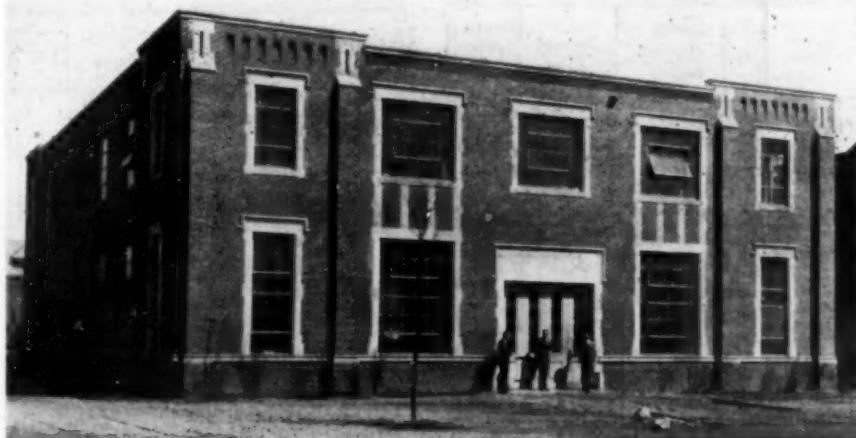
and through lectures and informal conferences to impress the students with the various elements that make for success in industrial work. This and other activities encouraged by Professor Sweeney have helped to develop an *esprit de corps* in the group which he calls his "chemical-engineering family."

He is proud of

the fact that of more than 100 graduates of his department, over 96 per cent are now engaged in distinctly chemical engineering work.

At present there are approximately 125 students in the department. The chemical engineering staff consists of two professors and two instructors who devote full time to the Chemical Engineering Department. In addition instructional assistance is provided from the Engineering Experiment Station.

"THE strength of our course," said Doctor Sweeney, in referring specifically to the new chemical-engineering building, "depends to a large extent upon the extreme flexibility of our mechanical facilities. We can build up or tear down or assemble operating chemical engineering unit process equipment in any combination we see fit. Thus if the manufacturing problem requires fusion, solution, filtration, crystallization and centrifuging, the equipment can be quickly assembled in an actually working process from which the student can obtain detailed data on yield, performance, cost, etc. This feature of flexibility, which is extremely valuable from an instructional viewpoint, would also make our chemical-engineering building an ideal place in which to establish chemical-warfare research, should an emergency occur.



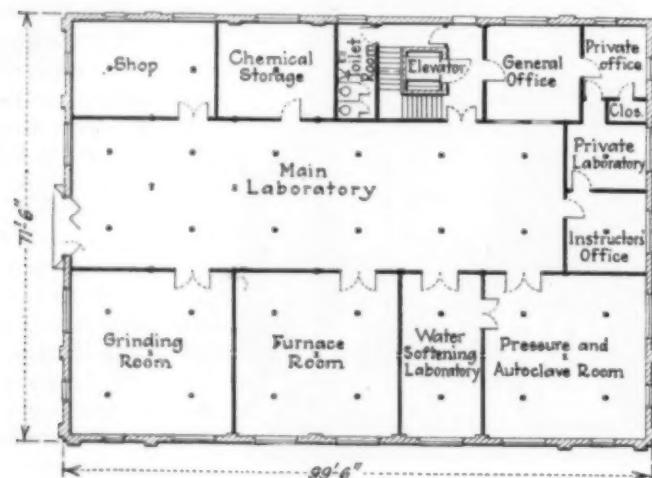
Front View of New Laboratory for Chemical Engineering Practice

The photographs shown here and even the bare floor plan give an entirely inadequate picture of the chemical-engineering building at Ames. It is actually a fairly sizeable two-story brick structure, approximately 100 ft. square. Like the course that is taught in it, it is primarily practical and likewise of logical and substantial construction. The building has been planned with an eye to the future for in reality it is but the first wing of a much larger structure. An adequate site has been provided for the necessary expansion.

The new building, which cost without equipment approximately \$60,000, contains only the executive offices of the chemical-engineering staff and the various laboratories, machine shop and similar accessories. The main laboratory, extending through the center of the building, is 85 ft. long, 25 ft. wide and has approximately 35 ft. of headroom since it extends into the monitor which covers this portion of the structure. The advantage of this height is apparent since equipment used in some of the work consists of commercial size fractionating columns, absorption towers, vacuum evaporators, etc. The main laboratory is surrounded by a balcony or mezzanine floor, and in the center of the building there is a concrete and

ing and classifying room in the southwest corner which contains practically all types of disintegrating equipment. Included here are gyratory and jaw crushers, ring, roll and swing-hammer mills, buhrstone, pebble and ball mills, a disk grinder, and in addition there is shredding and grinding machinery especially adapted for agricultural products. Next is the furnace room which is equipped with gas, oil and electrically heated furnaces. An interesting setup here is a retort for studying the destructive distillation of corncobs. Samples of the charcoal thus prepared appear to have many properties similar to hard-wood charcoal. A water-softening laboratory in the adjacent room is equipped with both lime-soda and zeolitic softening equipment. In the case of the latter process there is installed one of the household size Wardlo automatic, regenerating softeners which was designed by Professor Sweeney as a consulting engineer, and is being marketed by the Crane Company of Chicago.

**T**H E pressure and autoclave room is in the southeast corner of the building and contains the semi-commercial scale equipment for producing pulp from cornstalks. On the opposite side of the main laboratory is a well-



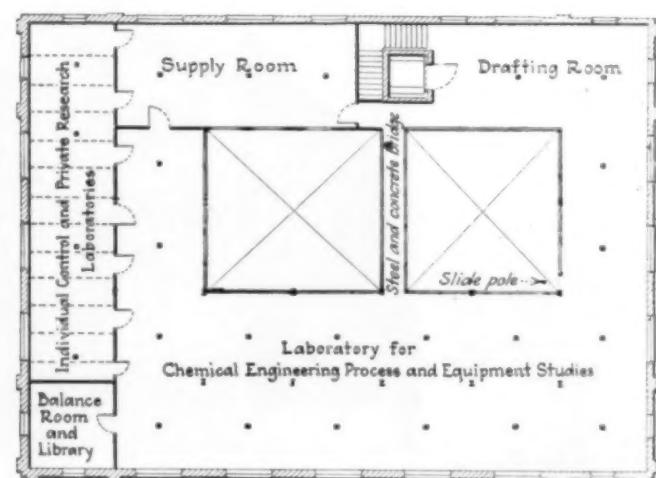
Figs. 4 and 5—Floor Plans Showing the Layout of Iowa State's New Chemical Engineering Workshop

steel bridge which connects the balcony on either side, and thus provides an ideal working platform when larger equipment is used on the main floor.

In general practice no equipment is permanently installed in the main laboratory except the facilities for providing gas, electricity, high- (150-lb.) and low-pressure steam, etc. In addition to portable motors there is an overhead shaft from which certain types of equipment may be driven. At the time of the writer's visit a full sized Hollander beater had been set up in the center of the main laboratory and was refining the fiber used in making synthetic building material from cornstalks. Another setup was a complete semi-commercial unit for making xylose and furfural from corncobs. This consisted of a digester, still and fractionating and condensing equipment.

**A** BASEMENT extending under part of the building contains a constant temperature fermentation room in which a number of semi-commercial fermenting vats have been installed. A part of the basement also serves as a blow-case room with connections to various parts of the building.

As indicated in the plan, the first floor contains a number of smaller laboratories. There is the crushing, grind-



equipped machine shop for making special apparatus and for the general maintenance and repair work of the department. Adjoining it is a storeroom for bulk chemicals, for motors, and other equipment when not in use.

Much of the teaching and research work centers on the mezzanine floor, which is substantially constructed of heavy reinforced concrete and, therefore, capable of holding very massive equipment. In fact, the principal process experimental and manufacturing equipment used in the instructional work is here. For example, there is a small sized double effect evaporator, condenser and pump, a 4-shelf 6x6 ft. Buffalo vacuum dryer, a 50-gal. vacuum strike pan, steam jacketed kettles, pressure and glass-lined digesters, centrifuges, filter presses, and a complete setup of small-scale paper making machinery including a cooker, Hollander heater, Jordan refiner, stuff chest, rod mill, pulp screen and sheet-forming machines.

At the west end of the mezzanine is the department library and seminar, the balance room and 8 special individual laboratories fitted up for graduate and advanced research men.

In addition to the equipment in the new building, the former quarters of the Department in the Chemistry Building house several absorption towers filled with various types of packing. There is also a cascade evapo-

rator furnace, coke fired, using 12 quart dishes. The electro-chemical laboratory, which is also in this building, contains an Allen-Moore cell, complete LaVinne oxygen-hydrogen equipment, and facilities for building up a wide variety of electrolytic cells. There is an Ajax-Northrup induction furnace and various equipment for building aluminum, silicon carbide and similar furnaces, and a motor generator set in the electro-chemical laboratory.

**P**ROBABLY the most impressive process equipment assembly in the new building is the synthetic lumber-forming machine which was designed in conjunction with and in part contributed by the Oliver Continuous Filter Company, the Downington Manufacturing Company, the Coe Dryer Company, and the Southwark Iron and Foundry Company. The combined equipment assembly is approximately 90 ft. in length. It takes the cornstalk fiber from the refiner, forms it into a continuous sheet an inch or more in thickness and 4 to 6 ft. in width. As the sheet leaves the pick-up roll of the Oliver it is cut into squares and carried continuously through the Coe dryer to emerge as insulating lumber. Or, in a semi-dry condition the sheet may be placed between the steam-heated platens of the Southwark hydraulic press and formed into the more compact and stiffer cornstalk wall board. A modification of this process is being used commercially by the Maizewood Company at Dubuque, Iowa.

This work on cornstalk utilization is definitely a part of the national farm problem. The United States Government through the Department of Commerce, has appropriated



Fig. 6—A Typical Student Group Studying Small-Scale Paper Manufacturing

\$50,000 for the study; \$25,000 has come from the State of Iowa, and \$10,000 from the Iowa State Engineering Experiment Station. It is also expected that perhaps \$50,000 additional will be available from the corn borer appropriation for studying improved methods of collecting cornstalks in the field. This extremely practical and promising research, which has been actively prosecuted by Professor Sweeney and his associates since 1920, has attracted international attention. Some of its results in the form of products made from corncobs and cornstalks were displayed at the last Chemical Exposition in New York, and it is expected that the subject will have considerable attention this summer at the Institute of Chemistry where Professor Sweeney, Dr. W. E. Emley of the industrial utilization of farm wastes. In a subsequent issue it will be the writer's privilege to describe a portion of the work that has been carried on at Iowa State.

## Industrial Specifications for the Chemical Engineer

**I**N CONNECTION with an investigation summarized in its recent Bulletin No. 13, the Society for the Promotion of Engineering Education asked a group of chemical engineers and employers for their opinion concerning educational policies and practices in the chemical engineering field. That there is an increasing comprehension, not only of the limitations and dangers of a highly specialized preliminary training, but also of the general desirability of a broad fundamental equipment, may be judged from the tenor of their replies as evidenced in the following quotations:

"Each year I am the more certain that the basic education of chemists, engineers, etc., should be broad, general, liberal, and that the engineering training should follow."

(President of firm)

"I doubt if more than one engineering student out of a hundred knows exactly what line of work he will eventually follow. Consequently, the time which is given to specific processes is largely wasted. It seems to me that the first requirement in education is the teaching of straight thinking. Next it is necessary to have sufficient fundamental information, which for the chemical engineer should include a real understanding of mathematics, physics, chemistry and economics. The ability to write well is highly desirable and the ability to read German and French is helpful. If these subjects are covered thoroughly there is not much time left in a four-year course for engineering technology."

(Research director)

"Education, in my opinion, is a question of *habitual* familiarity with ideas, subjects, methods and actual performance, rather than a question of knowledge *about* them. This habitual familiarity can only be acquired through training one's own faculties, not by watching someone else perform or listening to some one else talk about how a third person performed. Most of what we learn about things in college is quickly forgotten. A great deal of it is more or less incorrect anyway. We can find it in books if we need it. If we are any good we can hire some one to stand around and know it for us. But we must aim to compel the student to acquire by practice the faculty of using his own mental tools, his human tools and his mechanical tools with force, precision and dispatch on any material in any direction."

(Consulting engineer)

"Education is the foundation on which men are built, and success is not to be measured solely by dollars. Specialized engineering education does not develop men fitted for the emergencies which afford opportunities for advancement, neither is the product well rounded and interested in many things, outside of his specialized business, which were once considered as natural outlets for the spare time of the well educated men. Broad training and a continuance through college years of courses in the humanistics should give the type of man needed in the industries."

(Consulting engineer)

"A consideration would be useful of methods by which we could *separately* educate the artists and the artisans of engineering. I don't know how to make the original choice but I think we all know how to educate the two groups once the choice were made."

(Research director)

"A rigorous and thorough training in fundamentals should characterize the engineering course. Specialization should be reserved for graduate courses. Plant practice should be learned and studied in the field."

(General manager)

"As an employer of many chemical engineering graduates I have been convinced of the necessity for close co-operation between the engineering societies and the colleges."

(Consulting engineer)

# Ammonia Oxidation Replaces Niter for Chamber Acid Plants

*By S. F. Spangler.*

*Chemical Engineer, Chemical Construction Company,  
Charlotte, N. C.*

LAST YEAR witnessed a remarkable change in the attitude of the American chemical industry toward the oxidation of ammonia. After the completion, or in some cases the abandonment, of the large war-time plants such as those at Sheffield and Muscle Shoals, the process of ammonia oxidation returned to the status of a laboratory study or an experimental project for further study by some of the larger chemical companies. This was largely due to the then relatively high cost of ammonia as compared with nitrate of soda, but the idea that the oxidation of ammonia required a high degree of technical control also seriously retarded its general adoption by industry.

Admittedly the best conversion can only be attained by close technical control of the process and it is also true that plants for the oxidation of ammonia to form nitric acid are costly in construction. But during the past year the price of ammonia has been so low as to render it much more economical than nitrate of soda as a source of nitric acid with the result that one of the large chemical companies has erected several plants for the production of nitric acid from ammonia and at least two other large companies have similar large plants under construction. Another factor increasing the use of ammonia oxidation in the past year has been the independent development by several companies of small efficient oxidation units for supplying nitrogen oxides to sulphuric acid chamber plants. These small units have been developed to the stage where they can be efficiently operated by the average chamber-plant operator who generally has little if any of the technical training formerly considered necessary for this process.

The subject of ammonia oxidation on a large scale has been ably discussed elsewhere and received a great amount of attention at the sessions of the Institute of Chemistry in the summer of 1927. This article, therefore, deals principally with the small units which have been developed for use with sulphuric-acid chamber plants.

UNDERLYING the process of ammonia oxidation is the general principle that a mixture of ammonia gas and air, containing preferably 9 to 11 per cent NH<sub>3</sub>, when passed through a heated platinum gauze reacts to form oxides of nitrogen, chiefly NO. In order to secure the most efficient conversion of the ammonia to nitrogen oxides, together with long life for the platinum gauze, the gauze temperature is maintained at approximately 900 deg. C. as observed by an optical pyrometer and the ammonia-air mixture is preheated to a temperature of 200 deg. to 300 deg. C. The platinum gauze acts solely

as a catalyst; other materials have been tried as a substitute for platinum but so far without satisfactory results.

The small ammonia oxidation units now on the market differ principally in (1) the source of ammonia gas, (2) the method of preheating the ammonia-air mixture, and (3) the type of gauze and converter.

The ammonia gas may be obtained either from anhydrous ammonia or from ammonia liquor of a purity not less than that known commercially as "B grade." As anhydrous ammonia is under considerable pressure, special containers are necessary for its shipment and storage. Anhydrous ammonia may be purchased in cylinders containing 150 lb. NH<sub>3</sub> in which case it is customary to connect several cylinders to a manifold supplying the oxidation unit. Cylinders have the advantage of being easily and safely handled but naturally the price per pound of NH<sub>3</sub> in cylinders is higher than in larger con-

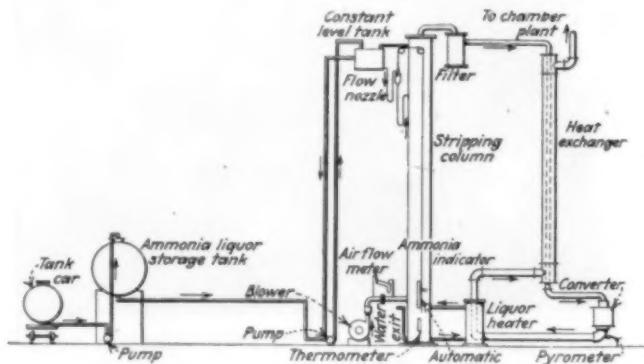


FIG. 1—Diagrammatic Arrangement of Ammonia Oxidation Unit Using Ammonia Liquor

tainers. Anhydrous ammonia may also be secured in tank car shipments in which case a compressor and a pressure tank, with walls over an inch thick, are necessary for its unloading and storage. As these pressure storage tanks cost upward of \$6,000 their cost is almost prohibitive for small units. Ammonia liquor is purchased in tank-car lots and stored in ordinary iron tanks. As the "B grade" liquor ordinarily contains 24 per cent to 28 per cent NH<sub>3</sub>, a larger storage tank is necessary than with anhydrous ammonia for the same net quantity of ammonia. As the ammonia requirements of oxidation units for chamber plants are comparatively small, however, usually but one storage tank of not over 12,000 to 15,000 gal. capacity is necessary. Since the cost per pound of NH<sub>3</sub> content of ammonia liquor averages from 10 per cent to 15 per cent cheaper than that of anhydrous

ammonia, the use of ammonia liquor is to be preferred for small oxidation units whenever it is available. For larger units supplying nitric-acid plants, or for a number of small units so located that service from one central storage tank is possible, it will generally prove preferable to use anhydrous ammonia because of the reduction of storage space required and the decrease in frequency of shipments to be received and unloaded.

**W**HEN ammonia liquor is used, ammonia gas is liberated by passing the liquor down through a packed tower or stripping column through which a current of air is forced counter-current, thus driving off most of the ammonia gas. The weak liquor accumulates in the base of the stripping column where it is heated to drive off the residual gas before being allowed to run to a sewer connection. It was formerly thought necessary to perform this heating by means of electric heating units or steam coils and the cost of this additional heating was regarded as a serious objection to the use of ammonia liquor. In some cases the steam was generated by the waste heat of the converter; while this reduced the cost of the heating it introduced additional complications into the apparatus. One of the improvements made to oxidation units during the past year resulted from the discovery that this weak liquor could be heated sufficiently to remove all the residual ammonia by allowing it to circulate through a jacket surrounding the pipe carrying the hot nitrogen oxides from the converter before it is run to waste. Even when starting up a cold unit, the use of an external source of heat is no longer considered necessary as the air passing up the stripping column removes enough ammonia gas to permit igniting the gauge, after which the converter soon furnished sufficient heat for the liquor heater to function. For the first hour after starting up a cold unit there is a partial loss of ammonia in the waste liquor but the small monetary value of this ammonia does not warrant the installation of special heating units.

If anhydrous ammonia is used, the preheating of the ammonia-air mixture may be accomplished either by heating the air alone prior to the addition of the ammonia or by heating the mixture. When ammonia liquor is used it is necessary to heat the mixture since if the air were heated to the required temperature before admission to the stripping column, the water content of the ammonia liquor would be evaporated and carried over with the mixture. In any case no external source of heat is required since the heating is done in a heat exchanger by surrounding the pipe carrying the cold gas mixture with a jacket through which pass the hot nitrogen oxides from the converter.

If the air alone is to be heated, it may be done in steel or iron pipe, but if the ammonia-air mixture is to be heated, the mixture must be contained in an aluminum or nickel pipe and after being heated it must not again pass through other than aluminum or nickel pipes before it enters the converter. If heated ammonia-air mixture is passed through other than aluminum or nickel piping there is a partial decomposition of the ammonia which greatly reduces the overall conversion of the unit. Obviously, therefore, a unit built with an iron pipe heat exchanger can be used only with anhydrous ammonia whereas a unit containing a heat exchanger in which the incoming cold gases pass through aluminum or nickel pipe can be used with either anhydrous ammonia or ammonia liquor. This is an important consideration in selecting the type of unit since varying market conditions

may make it desirable to change the source of ammonia after the installation has been placed in operation.

Originally several types of converters were in use including some in which flat electrically-heated platinum gauzes were employed. The general tendency of American practice now favors the use of the Parsons converter containing a cylindrical gauze built up of three or four layers of 80-mesh platinum gauze, of 0.003-in. wire, closed at the bottom with a silica disc. The gauze is hung from a nickel holder. The gases enter through this holder inside of the cylindrical gauze and pass out

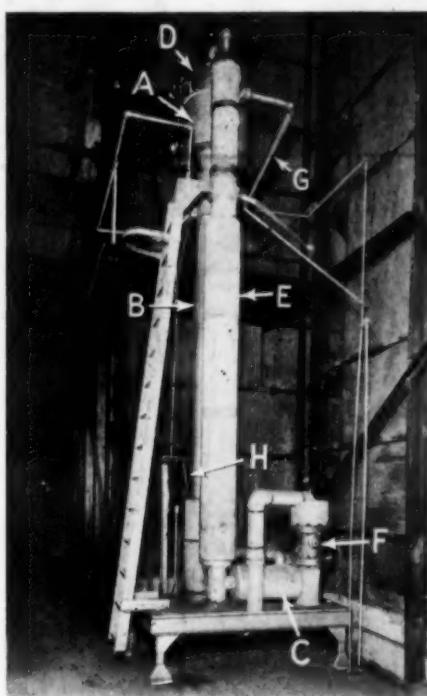


Fig. 2—Ammonia Oxidation Unit in Chamber Acid Plant of the Baugh Chemical Company, Baltimore, Md.

- A. Constant Level Tank.
- B. Stripping Column.
- C. Liquor Heater.
- D. Filter.
- E. Heat Exchanger.
- F. Converter.
- G. Pipe to Chamber Plant.
- H. Rear of Control Board.

through the sides of the cylinder. The converter consists of a cast iron or steel shell, lined with fire brick or other refractory material which reflects the heat back onto the gauze. Sight holes closed with Pyrex glass covers are provided in the sides of the converter for observing the condition of the gauze. When starting up a cold converter, the gauze is heated by a gas flame introduced through one of these sight holes while at the same time a rich (12 to 13 per cent NH<sub>3</sub>) ammonia-air mixture is passed through the converter.

**E**XACT control of the converter is obtained by observing the temperature of the platinum gauze through one of the sight holes with an optical pyrometer. As this procedure is too involved for routine practice in the average chamber plant, it is customary to insert a thermocouple in the gas stream leaving the converter. This is connected to an indicating pyrometer provided with a high and low temperature alarm bell. When the unit is first started up, the readings of this pyrometer are calibrated against gauze temperatures, observed by an optical pyrometer, at various rates of ammonia flow and this calibration is then sufficient for subsequent control of small units. While closer technical control might result in increasing the conversion by 2 or 3 per cent, the value of the ammonia saved by such increase would not equal

the cost of the closer control in the case of small units.

A diagrammatic view of a typical small ammonia oxidation unit using ammonia liquor is shown in Fig. 1. A constant level of ammonia liquor is maintained in the constant level tank near the top of the stripping column by means of a small circulating pump. From this tank the ammonia liquor flows into the stripping column through an adjustable flow nozzle. The amount of air introduced into the bottom of the stripping column is

drous ammonia. In such case the anhydrous ammonia, expanded into gas by passage through a reducing valve, is measured by means of a Venturi meter and introduced into the base of the stripping column which is now dry and serves merely as a mixing chamber. The constant level tank is disconnected from the stripping column and of course there is no liquor circulating through the liquor heater. In all other essentials the unit remains the same as when used with ammonia liquor.

Figs. 2 and 3 are views of one of the two units installed during the summer of 1927 at the chamber plants of the Baugh Chemical Company, Baltimore, both of which operate on ammonia liquor. Each unit has a capacity of up to 25 lb. NH<sub>3</sub> per hour, equivalent at a 92 per cent conversion to 115 lb. of 100 per cent sodium nitrate. Each is supported on a steel table, as shown, only 6 feet by 4 feet in size. Seven units of similar type were installed for use with ammonia liquor at various plants during the past year and a slightly greater number are now ordered for early installation this year.

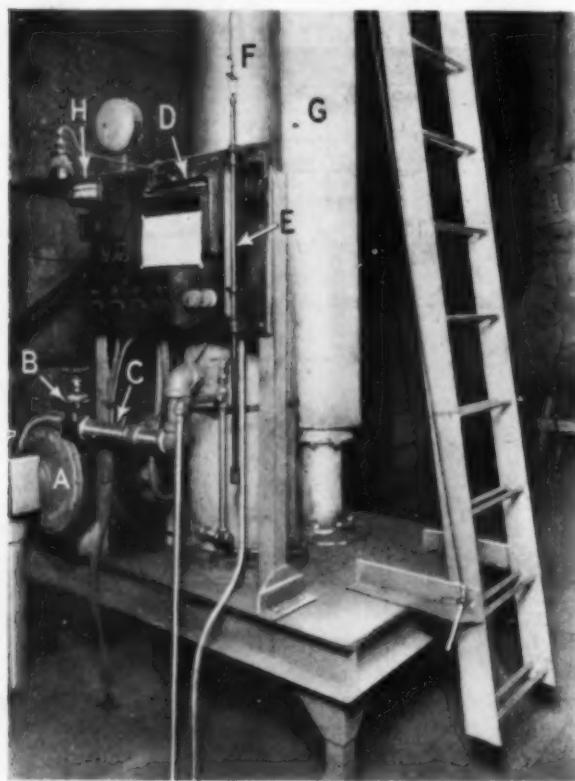


Fig. 3—Control Board and Lower Section of Ammonia Oxidation Unit

- A. Air Blower.
- B. Air Regulating Valve.
- C. Air Flow Venturi Meter.
- D. Differential Gage Connected to Air Venturi.
- E. Manual Liquor Flow Regulator.
- F. Lower Section of Stripping Column.
- G. Lower Section of Heat Exchanger.
- H. Pyrometer Showing Temperature of Gas Leaving Converter.

regulated by a valve and measured with a Venturi air-flow meter. Recent units have included means of automatically regulating the liquor flow in proportion to the air flow so as to maintain a constant strength of ammonia in the ammonia-air mixture, although the former method of manually varying the setting of the liquor-flow nozzle in proportion to the readings of the air-flow meter caused but little difficulty. The ammonia-air mixture leaving the stripping column is passed through a filter before entering the heat exchanger since any dust or impurities carried over into the converter would poison or otherwise damage the platinum gauze. To eliminate the chance of the ammonia-air mixture subsequently picking up dirt from the piping, only aluminum pipe is used between the filter and the heat exchanger. As previously explained, the ammonia-air mixture is carried through the heat exchanger and into the converter only in aluminum and nickel pipe and fittings. From the converter the hot nitrogen oxides pass through the inner pipe of the liquor heater and then the outer pipe of the heat exchanger and thence into the chamber-plant system.

This same type of unit can be employed with anhy-

WHILE ammonia oxidation units for sulphuric-acid chamber plants possess the advantages of a steady supply of nitrogen oxides, free from halogen acids and similar impurities, and minimum control and labor requirements, in the last analysis their chief merit lies in the low cost of producing the nitrogen oxides. While platinum gauzes must be renewed occasionally, there is a large salvage value in the old gauze, and the cost of all maintenance of the unit, including platinum renewals, averages less than the maintenance cost of nitre potting systems. No extra labor is required with an oxidation unit, although this is a factor with nitre potting only in the largest chamber plants. But the great saving lies in the cost of the raw materials used. A pound of ammonia is theoretically equivalent to 5 lb. of sodium nitrate. Assuming an average conversion in excess of 92 per cent which is easily maintained on the small units by an ordinary chamber-plant operator, and also recalling that commercial nitrate of soda is by no means 100 per cent NaNO<sub>3</sub>, it is clear that 1 lb. of ammonia in an oxidation unit will replace at least 4½ lb. of commercial Chilean nitrate in a nitre potting system. Since "B grade" ammonia liquor can be delivered at prices ranging between 6c. and 7½c. per lb. NH<sub>3</sub> content (depending on location relative to source of the liquor), the user of an ammonia oxidation unit secures the nitrogen oxides for his chamber plant at the equivalent of a price of \$25 to \$32 per ton for nitre. With Chilean nitrate selling at \$45 per ton and upward, there is a clear saving of \$20 to \$13 per ton on the raw material for production.

A 100-ton chamber plant operating on a 3 per cent nitre rate uses 1,250 lb. of nitre per day or about 220 tons per year, on which the saving by the use of ammonia oxidation would be between \$2,860 and \$4,400 per year. In addition, to drive off nitrogen oxides from 220 tons of nitre requires about 330 tons of 60 deg. Bé. sulphuric acid, worth, at \$7 per ton, \$2,310, all of which is saved by the use of an ammonia oxidation unit. Accordingly the total saving by the use of ammonia oxidation becomes between \$5,170 and \$6,710 per year for such a plant. As an ammonia oxidation unit, including ammonia liquor storage tank, of a capacity to supply a 100-ton chamber plant can be purchased complete, installed and in operation, for between \$6,000 and \$7,000, the reason for the recent rapid increase in the number of these units in American chamber acid plants is self evident.

# American Gas Association Studies Production Problems

## *Editorial Staff Report*

**E**XACT CONTROL and automatic operation of gas-producing equipment is shown to be the new order by the discussions of the joint Production and Chemical Conference of the American Gas Association, held May 22 to 24, in Rochester. This meeting of six sessions under the auspices of the Carbonization, Water Gas and Chemical Committees of the Association dealt with engineering and chemical problems in all phases of the industry. It gave, however, more than usual attention to coal-gas problems because the industry is rapidly appreciating the necessity of establishing itself with coal gas to supply the base load of the industry, at least in large communities. Approximately 400 engineers and chemists participated in these meetings. All of these sessions took on more than usual of a chemical engineering flavor because of the distinct tendency to adopt many well-recognized unit operations of industry to gas manufacture. This is due to the need for greater refinement in plant methods and greater exactness of process control.

In the manufacture of water gas, the use of bituminous coal has necessitated the development of a new operating technique. Special interest, therefore, attached to the symposium on this subject. Detailed reports of experience were given by five different engineers whose plant conditions differ widely. It was the consensus of opinion that practically all difficulties arising from the use of bituminous coal instead of coke or anthracite have been overcome. The only limitation appears to be in the capacity of generating sets, which is substantially reduced by use of soft coal.

Automatic operation of water-gas sets, both for charging and for clinkering, was the subject of one discussion. There was a general agreement that with automatic equipment, excellent oil efficiencies, low solid fuel consumption, increase in capacity and substantial reduction in labor are possible.

In co-operation with a number of utility companies, the Engineering Experiment Station of the University of Illinois has been investigating, for a number of years,

methods for testing, and the possibility of specifications for, water-gas machine refractories. Prof. C. W. Parmelee, who directed this work, reported on the investigation in a preliminary way and stated that the complete results of the study will be published in the University of Illinois bulletin 179, available in the near future. Since the measurable properties of the brick do not appear to be significant in determining plant performance, the experiment station recommends that a simple thermal shock test be used as the best basis for predicting life in service. This will serve at least to eliminate the less suitable brands.

The elimination of checker brick, all or in part, from the carburetor has been successfully tested in a number of plants. However, there is no general uniformity in experience. The majority of operators favor a partially checkered carburetor.

Estimating the efficiency with which gas oil is being used has long been a subject of controversy among water-gas operators. There is, however, an increasing confidence in the Wills method for estimating the quantity and heating value of the gas which comes from the oil. One of the most serious discrepancies in earlier work has been due to the fact that too high a heating value

has frequently been assigned to blue gas which usually has from 275 to 290 B.t.u. per cu.ft., and not the 300 B.t.u. often accredited to it. It now appears that the oil is contributing a larger percentage of total heat to the carbureted gas than has hitherto been assumed.

Data gathered and presented by Paul Ryan, statistician of the Association, show, despite a general recession in business during 1927, that the gas industry produced and sold about 3 per cent more gas than in 1926, establishing a new record for output. There was a slight decrease in water-gas production and a large increase in the use of coal gas and purchased coke-oven gas. This appears to remove all doubt as to the necessity for placing the industry on a coal-gas base load. The limiting factor in the trend toward coal-gas making is the limited market for coke. It was the consensus of

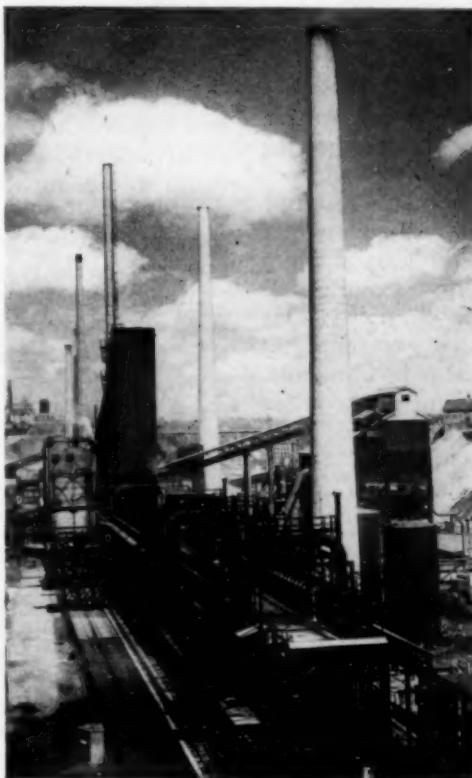


Fig. 1—Coke Oven Plant of the Rochester Gas & Electric Corporation



Fig. 2—Silica Gel Light-Oil Treatment Plant, Rochester Gas & Electric Corporation

opinion that the most promising immediate markets available are for household fuel.

These facts, among others, caused Walter C. Beckjord, chairman of the Technical Section, to stress the importance of taking a long-time view in the engineering planning of the industry. He emphasized the tendency toward long-distance transmission of gas with resulting centralized manufacture, especially in coal-gas works. He pointed out the tremendous increase in demand which is resulting from the lower cost of energy in coal gas as compared with other forms of fuel or electricity. He mentioned the elaborate study of mixed gas supply at the Central Laboratory of the Association in Cleveland, and the recently authorized investigation of methods for determining coking and gas-making properties of coal. The Association has very recently appropriated \$5,000 for this latter project to enable the Bureau of Mines to make an immediate start on an undertaking which it is hoped will receive governmental appropriation for its continuance.

Operating results on the Sterling, Illinois plant of Koppers continuous vertical ovens were presented by L. G. Adams, engineer of that works. He cited as the probable reason for complete elimination of sticking of the coal in this type of oven the following factors: (a) Maintenance of the proper proportions of coarse and fine coal in the charge. (b) Use of a larger oven than in most vertical units hitherto built. (c) Feeding the coal through a water-cooled spout so that it is admitted directly to a hot section of the oven wall—bypassing the cooler wall section directly under the charging opening. (d) Uniform heat distribution in the ovens. He also mentioned that the plant is producing 6.13 cu.ft. of 567 B.t.u. gas, equivalent to 3,487 B.t.u., per lb. of coal processed. A southeastern Kentucky coal is used. Producer fuel for under-firing the battery requires 186 lb. of small coke and breeze per ton of coal carbonized.

A paper prepared by Prof. J. T. Ward, of the Massachusetts Institute of Technology, and presented by T. A. Mengelsdorf, one of his associates, summarizing four coking-plant tests which have been conducted during the last four years under the Carbonization Committee of the Association. The four radically different carbonizing plants gave surprisingly similar performance data. Heat balances are very much alike. There is some substantial difference in the heat required to process a pound

of coal in the different systems, but these differences are more apparent than real. The most important data derived from these studies deal with the relative yield of different products. Some systems produce more coke and less gas, others more tar, and still others more of other products. Local conditions often determine the most desirable distribution of yields. The data also include information on the probable advantage of dry quenching of coke, the effect of operating conditions on ammonia and other byproducts yields, and like significant figures which are often the determining consideration in judging the type of plant. The plants investigated included coke ovens, continuous verticals, intermittent verticals and horizontal retorts.

The possibility of securing better prices for ammonia liquor of higher purity was discussed. It was pointed out that the premium obtainable unless ammonia is of "powder liquor" grade is so small as to be negligible. The cost of making this superior grade liquor, because of the increased equipment required, will often more than offset the increased sale price. This discussion was followed with the experiences of R. L. Fletcher, of the Providence Gas Company, in using an indirect sulphate process. A saving of spare equipment, flexibility, elimination of tar trouble in the salt, better salt color and the feasibility of a higher reaction temperature in formation were cited as advantages, while increase in land, equipment, labor, liquor storage capacity and still-waste disposal difficulties, constituted the disadvantages. In his opinion, a direct recovery unit is better for the large plant. Local conditions govern the preference for small plants.

Modern plant control equipment is being widely used and is now generally appreciated as essential for efficient operation. Closer attention to specific gravity is being given, because of the increasing use of mixed gases in large cities. As a consequence, there has been an increased demand for automatic specific gravity indicators and recorders.

Results in automatic control of heating values by the mixing valves used with the Thomas automatic calorimeter were discussed. This device combines a quick-

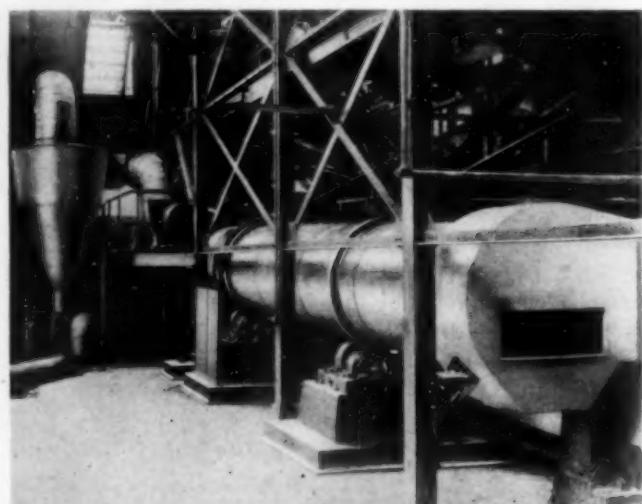


Fig. 3—Ammonium Sulphate Drier, Rochester Gas & Electric Corporation

acting unit for approximate adjustment of heating value, with accurate control through the use of the Thomas calorimeter. The heating value of a mixed gas supply can be maintained with this combination within 0.5 per cent of the desired figure. A number of speakers re-

ported on the very satisfactory improvement in plant efficiency resulting from regular use of either Thomas or Parr automatic calorimeters. These experiences indicated the necessity for accurate, and even elaborate, control equipment in the small plant as well as the large.

Problems of naphthalene removal, control of gum-forming constituents in gas, purification from sulphur compounds and handling of tar and tar emulsions were questions that developed much interest. A very large number of works are now using typical chemical engineering equipment and methods for oil-washing the gas to control naphthalene contained, and to remove gum-forming constituents, much after the fashion of light-oil removal practiced by these works during the war. However, the smaller types of rotary washers are more frequently in use now than formerly. Advantages of such oil washing under proper conditions are not alone limited to naphthalene, as the problems of sulphur removal and elimination of distribution stoppages are important attendant advantages.

The next topic was the discussion of F. W. Sperr on the four recognized methods of liquid purification of gas for  $H_2S$  removal. The contaminated air from the Seaboard process, carrying  $H_2S$ , has been successfully handled by passing under boilers, through retort recuperators, into water-gas machines, or into gas producers. The iron and nickel processes, which are modifications

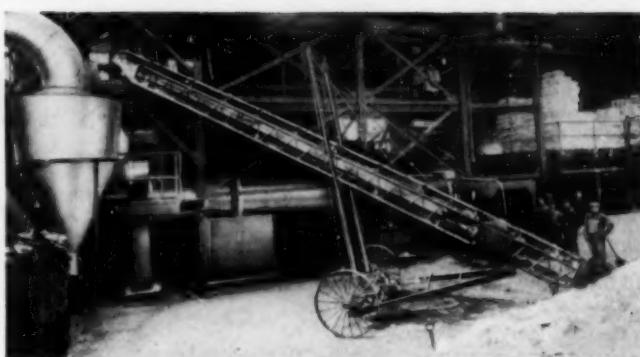


FIG. 4—AMMONIUM SULPHATE HANDLING EQUIPMENT, ROCHESTER GAS & ELECTRIC CORPORATION

of the Seaboard scheme, are being commercially used in a number of plants. The new "Thylox" process uses clear solutions and provides a recovery of sulphur in a pure, colorless form for easy disposal for chemical uses.

A great deal of development work is now being done in a number of gas plants to insure emulsion control, low water content of tar, and prevention of tar or oil in works effluents. Many gas works are now adapting to these problems much well-known chemical engineering apparatus in the way of decanters, centrifuges, and other process equipment.

## Fuel Industries and the Work of the Chemical Engineer

**I**N HIS ADDRESS on May 14 before the Society of Chemical Industry Conference, Sir Arthur Duckham, first president of the Institution of Chemical Engineers, spoke on the relation of the chemical engineer to the fuel-using industries. Chemical engineering, he said, stands for efficiency in operation and development, and therefore its application to the fuel industries is of vital importance. A chemical engineer is a man having sufficient chemical knowledge to appreciate the trend and results of chemical research and the ability to use such knowledge to initiate or improve methods and processes, and having sufficient engineering training and practical experience to devise and operate plant with which to obtain the desired results.

This subject of chemical engineering in relation to the fuel-using industries is a very wide one, and should begin with a statement of those industries which are touched upon:

- (1) The production of coal and its preparation for the market.
- (2) The carbonization of coal.
- (3) The preparation of oils from coal.
- (4) The manufacture of pig iron.
- (5) The manufacture of steel up to the billet form.
- (6) The use of coal for the production of industrial heat and power, and especially for electrical energy.
- (7) The heating of kilns and furnaces in general.

In all these phases of industry the chemical engineer eventually must play a determining part.

At the colliery, the chemical engineer is the man who should reduce maintenance costs by proper choice and control of stores. He furnishes technical assistance to the manager in regard to the chemical and physical properties of coal—calorific power, ash characteristics, effects of blending different coals from the same pit. His use-

fulness lies in the fact that good service will become the chief selling factor for any producer.

The carbonization of coal and the recovery of its by-products can only be carried out efficiently under the direction of a chemical engineer. He has also to work out suitable refractories; there is much work to be done in connection with the processing behavior of various coals; the collection and treatment of byproducts of carbonization is the very essence of chemical engineering. This is the job for a man who can talk with the chemist and understand his viewpoint, and yet knows the snags of operation, who can tell the engineering designer and constructor what he wants in terms that are attainable and economic in operation.

Those of us who have seen such processes as the Bergius in operation and realize the immense amount of work accomplished and still to be done in connection with the preparation of oils from coal can appreciate that it is only by practical experience that the difficulties can be discovered; only by a sound knowledge of chemistry and engineering that they can be overcome. Here is a future field of greatest importance for the chemical engineer.

In the pig-iron industry, the chemical engineer has work to do in connection with the specification of materials and conditions; in the manufacture of steel he must deal with coke ovens and the utilization of blast furnace gas. Where coal is used primarily for power, he must eliminate the difficulties arising from the use of low-grade fuels and help to produce cheaper B.t.u. And where materials are heat-treated in kilns and furnaces, it is estimated that there are potential savings of 30 to 50 per cent in fuel to be made by the chemical engineer.

Let us appreciate the necessity for chemical engineers in the fuel industries—let us create the demand—I am sure it will be met. We must treat these men well; high salaries properly earned are a sound investment. In any of the operations that I have mentioned a good man can earn a good salary many times over.

# A World View of Nitrogen Economics

By Dr. Julius Bueb

Managing Director of the Nitrogen Syndicate  
Berlin-Dahlem, Germany

**EDITOR'S NOTE.** Dr. Bueb's very comprehensive paper, entitled "Nitrogen Economics: Retrospect and Prospect," was written for the International Nitrogen Conference held on board S.S. "Lützow" during its Adriatic cruise last month. (See "Chem. & Met." page 313, May, 1928.) It is presented herewith in slightly abbreviated form and other of the nitrogen discussions will be published in subsequent numbers of "Chem. & Met."

DURING the decade immediately preceding the war the use of nitrogen in the world was on the increase but this development was checked on the outbreak of war. Owing to military requirements the consumption of nitrogen for agricultural purposes for a time fell below the pre-war level. When the production again became available for agriculture after the war, supply was at first unequal to demand, and it was only from the year 1924 onwards that it was possible to meet all requirements.

It might have been expected that after the enormous difficulties created by conditions during and after the war had been overcome, the consumption would for a time have been reduced to the 1914 level. The event has shown however—and this is a remarkable fact—that the demand was growing all the time as if the pre-war development had never been interrupted. Probably the temporary shortage assisted the recognition of the importance of nitrogen. The columnar diagram in Fig. 1 shows this development clearly. Another interesting fact also emerges from this diagram. Before the war Chilean nitrate of soda took its full share of the

general increase in demand, but during the last few years its use, far from increasing, has actually diminished.

Cheap synthetic nitrogen has not only succeeded in capturing the whole of the general increase in the world consumption of nitrogen, but has also encroached on the domain of Chilean nitrate of soda.

During the present fertilizer year the price of Chilean nitrate of soda has been reduced and we must therefore reckon with a considerable increase in the demand for this product.

A comparison between the consumption and production of nitrogen fertilizers during the last few years is shown in Fig. 2. The consumption of nitrogen in the current fertilizer year may be expected to amount to more than 1.4 million tons of pure nitrogen; that is 700,000 tons more than in the year immediately preceding the war. The consumption curve will therefore continue to move upwards. Quite apart from the limitation on the use of Chilean nitrate imposed by economic considerations, the Chilean nitrate industry by itself could only have supplied a portion of this increased demand of 700,000 tons. Nor would the production of ammonia at coke ovens and gas works have sufficed to supply the balance of the demand, because that production depends on factors other than the demand for nitrogen.

The necessity of supplying the food requirements of the world would therefore have made imperative a continuation of the conditions obtaining during and immediately after the war, when large areas were used for the cultivation of agricultural products, which were not naturally well suited for such production, some of these being cultivated for the first time and others being put under intensive cultivation. The cessation of this state of affairs, temporarily necessary but economically unsound, is very largely due to the synthetic nitrogen industry, for with the help of intensive treatment with fertilizers and other suitable measures, the productivity of the old cultivated areas was raised above the low level reached during and after the war. It may be confidently claimed that this development also contributed towards the lowering of the prices for agricultural produce.

The expansion of the synthetic nitrogen industry had another important economic result, for without the competition from this source, prices for Chilean nitrate of soda and by-product ammonia would certainly have followed the general tendency and risen far above the pre-war

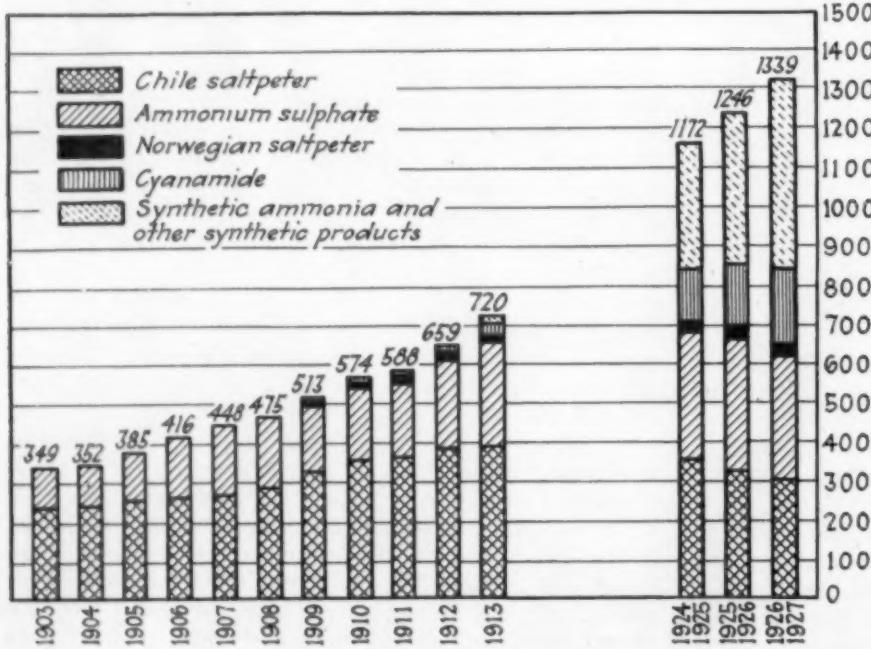


Fig. 1—World Consumption of Nitrogen in Units of 1,000 Tons of Pure Nitrogen

price. The natural consequence of this would have been a further increase in the cost of food. But if any attempt had been made to stop this rise in the cost of living by means of Government interference such as actually continued for a time after the war, this would have hampered cultivation in the areas in question. The world's food supply would have been in jeopardy as a consequence.

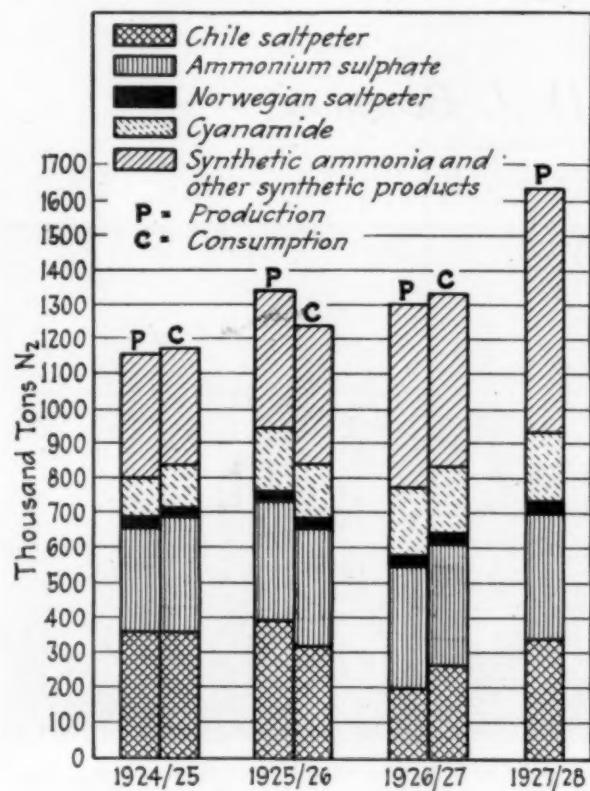


Fig. 2—World Production and World Consumption of Nitrogen (N₂) for Fertilizer Years 1924 to 1928

It may therefore be said that the synthetic nitrogen industry saved the world from high prices and famine. It is due to that industry that it has been possible to make good the great damage caused by the World War through improvident cropping, impoverishment of the soil, neglect of proper cultivation, lack of suitable seed and the like. In the countries which suffered most from the war, crop yields per hectare have again attained the pre-war level; they are now tending to exceed that level as in the case of countries which suffered to a lesser degree.

IF WE ask how the production and consumption of nitrogen are likely to develop in the next few years I believe that, as a logical conclusion of the considerations which I have put before you, we may say that the curve of nitrogen consumption is likely to continue to show the same rising tendency provided that nitrogen prices do not increase and provided that no material alteration takes place in the prices for agricultural produce, that is to say, as long as supply and demand for agricultural products about balance. Of course, if the increasing application of nitrogen should one day result in such an excess output of agricultural produce as to cause a fall in its value, the upward movement would no doubt be interrupted until the growth of the world's population made a further increase in agricultural production necessary.

Both in its own interest and for general economic considerations the nitrogen industry must endeavor to produce as cheaply as possible and must be content with small profits per unit of nitrogen. It must seek prosperity in production on the largest possible scale which is consistent with certainty of outlet.

The efforts which are being made by modern synthetic nitrogen works to produce nitrogen fertilizers at the lowest possible cost involve very large capital outlay and provision for depreciation on a high scale, because unlike older processes which have been fully explored, the high pressure process is still capable of improvement. The technical discoveries made in the scientific research laboratories of the nitrogen works are put into practice as quickly as possible even if this means scrapping apparatus which has not yet been used and replacing it with better plant. These outlays are balanced in the course of time by the higher yield obtained and by savings in heat units and man-power, and thus in the end lead to the goal aimed at, namely the cheapening of nitrogen. With a view to increasing the consumption, we must give consumers the advantage of lower cost of production. Means must therefore be found of delivering fertilizers to the agriculturalists in the most economical way.

**N**O OBSTACLES should be put in the way of the nitrogen industry to prevent it from developing in this manner. That industry will only produce at the lowest cost if purely economic considerations govern the erection of factories. Such considerations are primarily: (1) Low capital cost per unit produced; (2) Cheap energy from coal or electric power; and (3) Cheap labor cost.

Nitrogen industries which owe their existence to political rather than to economic considerations and are designed to provide the plants for the production of raw material for explosives in case of war will not, generally speaking, be able to satisfy these requirements. If conditions for production are unfavorable, such factories cannot be self-supporting but will require artificial assistance in the shape of protective tariffs or subventions. In the last resort the cost of such measures must fall on the agricultural interests in the countries concerned. Farmers in every country should therefore demand that nitrogen works should only be built and maintained with a view to the lowest possible cost of production. It should be the task of the politician not only not to create but to remove any obstacles which lie in the way of the realization of this common interest of the nitrogen industry and agriculture.

Governments and parliaments of all countries should work together with the object of increasing the production of crops and of reducing in this way the general price of food.

Their assistance should extend along the following three lines: (a) Provision of cheap freight rates for the most important raw material used in agriculture, namely nitrogen fertilizers. (b) Abolition of all tariff duties on nitrogen fertilizers. (c) Support of credit institutions which place cheap money at the disposal of the farmer, enabling him to finance the purchase of nitrogen fertilizers until he can sell his crop.

The whole world would derive profit from such co-operation between governments, parliaments, the nitrogen industry, and agriculture, for the nations would then be furnished with the cheap and abundant supplies of food which they require.

# Operating a Continuous Plant for Refining Distillates

By J. C. Morrell and D. J. Bergman

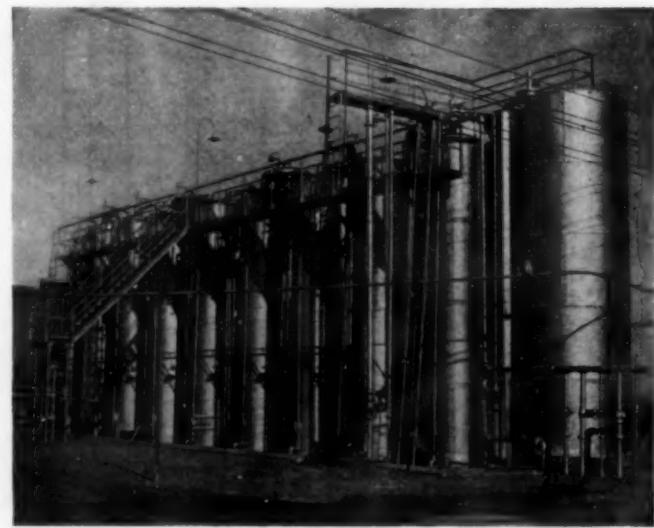
Universal Oil Products Company, Riverside, Ill.

**EDITOR'S NOTE:** Liquid handling, mixing, agitation and settling are unit chemical engineering processes involved in the chemical operations in refining gasoline and related petroleum distillates. In previous contributions published in the April and May issues of Chem. & Met., Drs. Morrell and Bergman have discussed the principles underlying the design and construction of the various equipment for chemical treatment of distillates in petroleum refineries. The present article concludes the discussion of design and then describes the usual practice involved in operating modern treating plants. Operators in related industries will find much of interest and value in this discussion.

CONTINUOUS treating-systems consist of a combination of mixing, settling, and washing equipment, the particular order depending upon the method of treatment. Each individual step or reagent in the treatment requires a mixing and settling element.

A simple continuous treating plant is shown in Fig. 14. The pressure distillate is pumped, together with the acid, through a mixer which may be of an orifice, packed tube or mechanical mixer. The distillate and acid sludge then flow into the lower part of the acid-settling tank where sufficient time is allowed for settling of the acid sludge. The overflow goes to the lower part of the water-wash tank where a water-spray in the top of the tank effectively washes the acid from the oil. The overflow next goes to a plumbite mixer and then into a plumbite settling-tank.

From this tank the treated pressure distillate is taken directly to storage without washing. Some caustic settles out in the storage tank and may be drained off occasionally. This will tend to protect the bottom of the tank from acid corrosion. It is also found that a small amount of caustic in the oil tends to give a sweeter product on distillation. After distilling, the gasoline is pumped through a caustic mixer with a small percentage of



View of a Modern Continuous Treating Plant

fresh weak caustic, and then flows into the caustic settling wash tank. The overflow goes to the finished gasoline storage.

The inlets on all these tanks should be placed tangentially and the water sprays are made with all holes facing in the same direction so as to assist the rotating motion set up by the tangential inlets. In this way the distillate is carried under the water spray and is given a more thorough washing.

A more detailed arrangement of an assembled continuous treating plant for pressure distillate and for the gasoline from the treated pressure distillate is shown in

Fig. 15. The capacity of this particular plant is 125 bbl. per hour, but the principles of design are applicable to a plant of any capacity.

#### Design of Orifice Mixing Columns

—The design of the mixing elements has already been discussed. In the present case the complete design will be given. Method 2 of treating cracked distillates is used. Hence there are three principal steps in the treatment; namely, acid treatment and settling, water-wash and settling, and plumbite treatment and settling.

(a) Acid Mixing Column — An 8-in. diameter pipe or column, 25 ft. high, will serve for this purpose. The 6-in. recirculating baffle coils for mix-

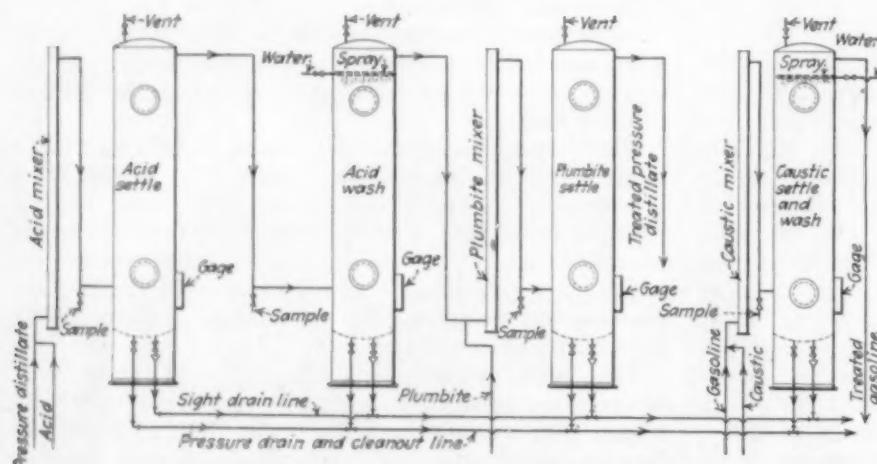


Fig. 14—Flow Sheet of Continuous Treating Plant

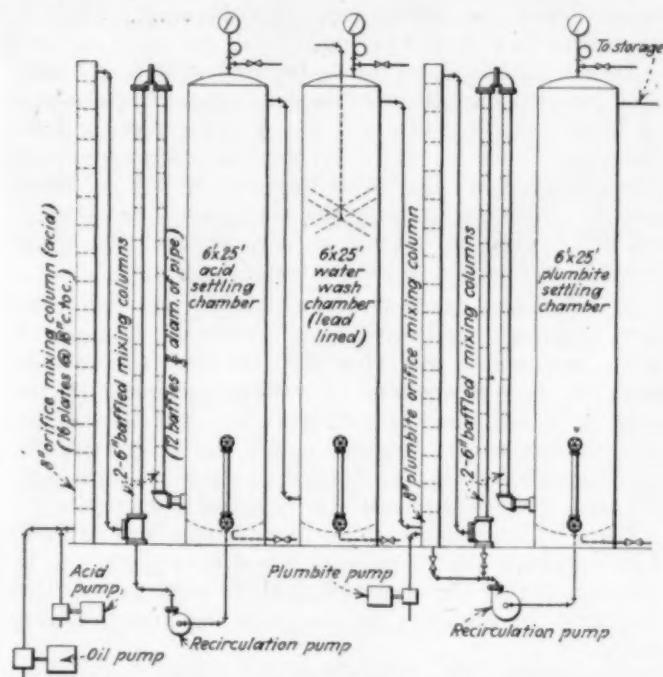


Fig. 15—Continuous Treating System for Cracked Distillates  
(Capacity of 100 to 125 bbl. per hour.)

ing, also shown in the drawing, are to be 25 ft. high.

A total back pressure (pressure drop) of 30 lb. on the orifice column will serve for acid mixing. This is equivalent to 1.9 lb. per plate or a pressure head for a cracked distillate of 52 deg. Bé. gravity of 5.64 ft. At a charging capacity of 125 bbl. per hour, the total orifice area required is 2.13 sq.in. Allowing  $\frac{1}{8}$  in. clearance around the plate will leave an orifice area of 0.56 sq.in. per plate. This is equivalent to an opening  $\frac{3}{8}$  in. diameter or two openings  $\frac{1}{2}$  in. diameter. Each orifice plate is to be made with two openings,  $\frac{1}{2}$  in. diameter, and the openings in alternate orifice plates are to be staggered. The plates are fixed upon a rod by welding as shown in the accompanying drawing, and the whole ensemble is dropped into the column. (Fig. 16.)

The purposes of the baffled column is to effect a longer time of contact and mixing than that given by the orifice column and also to recirculate separately the plumbite and acid. Recirculation of the plumbite or caustic is necessary in order to make full use of the reagent; the recirculation of the acid sludge will depend on local conditions. The arrangement for recirculating the acid is simple and should be provided.

(b) *Plumbite or Caustic Orifice Columns:* The mixing requirements for plumbite or caustic are not as exacting as those for acid; a back pressure (pressure drop) of 15 lb. has been shown by experience to be adequate for this purpose. This is equivalent to a total head of 2.9 ft. of oil per plate, using 16 plates as shown.

At the rate of 125 bbl. per hour, the total orifice area required will be 3.2 sq.in. Allowing an area of clearance of 1.57 sq.in., equivalent to a uniform clearance of  $\frac{1}{8}$ -in. around the plate, the orifice area required will be 1.62 sq.in. This area may be divided between two openings of  $1\frac{1}{2}$  in. diameter. The general arrangement and construction of the plates and the column are the same as for the acid mixing column. The same type of baffled coil is used.

It is important that the orifice openings in each plate be at right angles to the orifice openings in the adjacent plates. This provision gives a staggered arrangement

of the orifice openings and causes a change in the direction of the flow of the liquid in passing from plate to plate.

*Settling Tanks or Chambers:* The dimensions of the settling chamber or settling tank must be chosen to insure sufficient time of settling for all reagents. For pressure distillate approximately one hour is ample. Hence a 6 ft. diameter tank, 25 ft. high, would serve the purpose. All tanks should be tested to a safe working pressure of approximately 100 lb. by hydrostatic tests. The plumbite settling-tanks may be built to withstand a lower pressure; e.g., 75 lb.

The water-washing tank following the acid treatment is lined with 8 to 10 lb.-lead to avoid corrosion. The washing chambers are equipped with sprays as shown in the drawing.

A gasoline treating plant for improving the odor and stability of the gasoline by washing with caustic solution and water is also shown in Fig. 17. The operation of this plant will be described in the remaining portion of this paper which will discuss the operation of the continuous treating-plant for pressure distillate.

### Operation of Continuous Treating Plant

The oil and acid are fed into the acid-mixing orifice-column and passed into the baffled column, discharging into the settling chamber where the sludge is settled. The point of discharge is about 4 ft. above the bottom of the tank (usually one-sixth the height of the tank). This location is important, since it affects the separation of the oil from the sludge. The gage-glass permits maintaining of the level and allows proper regulation of the withdrawal of sludge.

The oil overflows into the water-wash tank, where it is continuously sprayed with water, and from there into the plumbite orifice-mixing column where neutralization and partial sweetening occur. The baffled mixing-column permits recirculation of the partially used plumbite from the plumbite settling chamber.

The oil overflows from the plumbite-settling chamber under the pressure of the charging pump and is discharged to storage. The acid-sludge recirculating pump may be used, if found desirable, the baffled coil permitting separate recirculation of the sludge. The baffled coil also serves the purpose of lengthening the time of reaction between the acid and the oil.

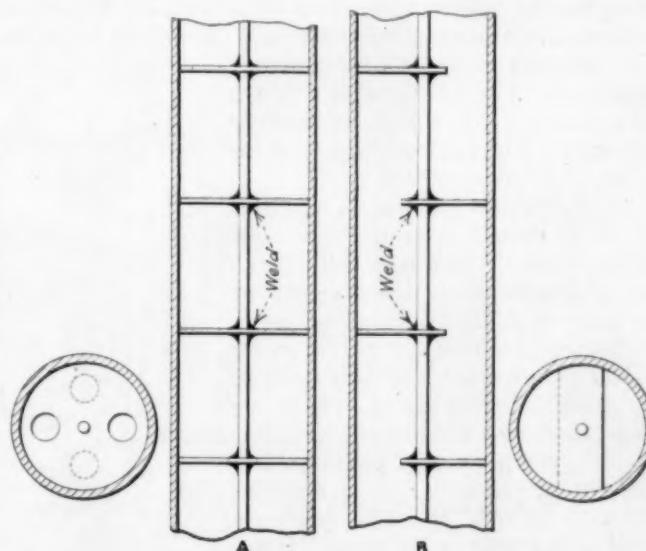


Fig. 16—Details of Construction of Mixing Columns

The operation of the gasoline-treating plant is also very simple. Gasoline from the still is pumped into the gasoline-treating plant together with about 1 per cent by volume of approximately 3 deg. Bé. caustic. Stronger solutions than this sometimes affect the color of the gasoline and this concentration will serve to remove hydrogen sulphide. This treatment improves the color and stability of the gasoline.

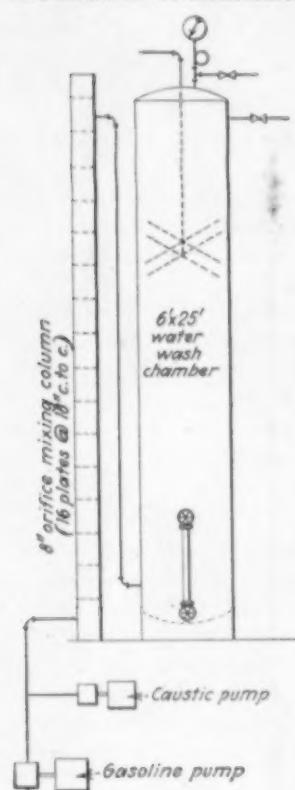


Fig. 17—Continuous Washing System for Gasoline.  
(Capacity 100 to 125  
Bbl. per Hour)

has the further advantage that in the water-washing system separate tanks may be utilized for washing and for settling.

In some cases it is desirable to have a short time of contact between the acid and oil, and under these conditions the baffled column in the acid-mixing element may be eliminated.

For Method No. 3 (see *Chem. & Met.*, p. 293, May, 1928) the arrangement shown in Fig. 18 is suitable. This plant has the additional features of preliminary treatment with plumbite or caustic solution and the mixing elements are designed in the manner already described. The following is a design of a plant for 100 barrels of distillate per hour. The principles apply to the design of larger plants.

*Acid-Mixing Column:* An 8-in. diameter pipe or column, 20 ft. high, is to be used. The 6-in. baffled columns also shown in the drawing are to be 20 ft. high. A total back pressure (pressure drop) of 30 lb. on the orifice column for acid mixing is to be used. Fifteen orifice plates are to be used, which would be equivalent to 2 lb. per plate or a pressure drop for the oil of 6 ft. At a charging capacity of 100 bbl. per hour, the total orifice area is 1.8 sq.in. Allowing  $\frac{1}{8}$  in. clearance around the plate

would leave an orifice area of 0.24 sq.in. This is equivalent to a  $\frac{1}{16}$ -in. opening.

Hence, fifteen plates are to be used with  $\frac{1}{16}$ -in. clearance between the plate and the 8-in. pipe. Each plate is to have a  $\frac{1}{16}$ -in. opening, 3 in. off the center, and the plates are to be so positioned that the opening in each alternate plate is staggered with respect to the preceding and the following plate. The plates are fixed upon a rod by welding as shown in Fig. 16, and the whole ensemble is dropped in the column.

*Plumbite or Caustic Orifice Columns:* A back pressure (pressure drop) of 15 lb. upon the plumbite columns, both before and after the acid treatment, will be used for these treatments. For fifteen plates, 1 lb. per plate or a 3-ft. head is sufficient. At 100 bbl. per hr. the total orifice area required is 2.5, and subtracting the area equivalent to  $\frac{1}{16}$  in. clearance leaves 0.47 sq.in. orifice area, which is equivalent to two  $\frac{1}{4}$ -in. openings.

The  $\frac{1}{4}$ -in. openings in the orifice plates are to be made 3 in. on either side of the center and each plate is to be adjusted so that the openings upon the plate are at right angles to the openings on the preceding and following plates.

The construction of the plates and column is the same as for the acid mixing column.

*Baffle Column:* The purpose of the baffled column following the orifice column is to permit a longer time of contact and mixing than that given by the orifice column, and also to separately recirculate the plumbite and the acid. This recirculation is not imperative in the case of the acid, but gives better results with the plumbite and makes for economy. The method of constructing both the orifice column and the baffled column is shown in Fig. 16.

*Orifice Tube:* An orifice tube shown in the drawing is used for preliminary mixing of acid, immediately following the water-wash after the plumbite treatment. The purpose of this orifice tube is to permit a portion of the acid to contact with the oil before the main acid treatment is applied in order to remove water and also to complete the reaction with the plumbite where used. By this means combinations of dilute and concentrated acid may be used when found desirable.

This orifice tube will be discussed further under the operation of the plant, the present remarks being directed toward design and construction. The tube is made up of 8-in. pipe, 7 ft. long, and contains 5 orifice plates each with two  $\frac{1}{4}$ -in. openings, making a total of approximately

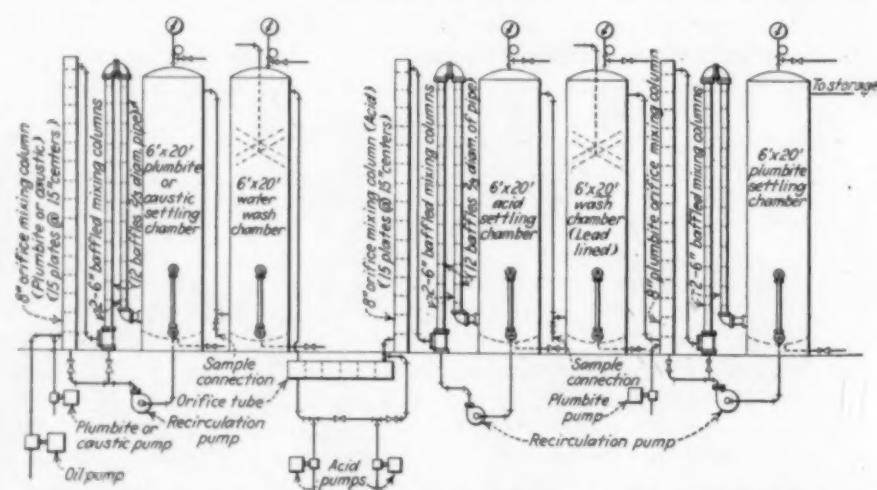


Fig. 18—Continuous Treating System for Split Plumbite or Preliminary Caustic Method

5 lb. back pressure (pressure drop) in this tube. The plates are spaced at 1-ft. intervals.

The use of orifices or pumps for proportioning the acid is optional. The pump is preferable as the orifices tend to clog or wear irregularly.

### Operation of Treating Plant

The oil and plumbite or oil and caustic are fed into the plumbite or caustic orifice-mixing coil and overflow into the baffled coil discharging into the plumbite or caustic settling chamber. The unused caustic or plumbite is con-

sions of the settling chamber and proper design of the mixing elements as described must be considered.

In conjunction with the doctor treatment of straight-run gasolines with plumbite solution and sulphur in continuous treating plants, a suitable method of introducing the sulphur is to by-pass a small amount of distillate controlled by an orifice through a cylinder containing molded sticks of sulphur, known as brimstone sulphur, the amount of distillate so by-passed being controlled so that the proper amount of sulphur is introduced into the mixture when the stream enters the main line again.

*Equipment:* The overflow lines connecting the tanks as well as the baffled mixing-columns, which serve to connect settling chambers with the orifice mixing-columns, will enter the tanks at a height of approximately 3½ ft. above the bottom of the tank. The connections to the tanks from the overflow lines should enter the settling tanks tangentially. This facilitates settling.

The water sprays are perforated pipes. The perforations are arranged in one or two sets at the bottom of each pipe, each line of perforations being sufficiently to one side of the middle line of the bottom to cause the water to discharge at a slight angle.

Two sets of sprays, each composed of two crosses, making a total of 8 arms, are used. The plan view would show 8 arms radiating regularly from the center.

In the construction of the spray, which was described in Part I (see *Chem. & Met.*, pp. 210-214, April, 1928), threaded fittings may be utilized. The bottom spray is located approximately one-third of the distance from the top of the tank and the other spray is located just above it. This arrangement will allow twenty minutes for the separation of the water from the point of injection.

Self-lubricating stopcocks, such as the Merco Nordstrom or MacGregor should be used upon the reagent lines. Steel pipes may be used except for the line leading from the acid-wash tanks. This pipe should be lead-coated or lead-lined. These acid-washing tanks are lead-lined to prevent corrosion. Drain lines should be made of steel pipe and furnished with block valves and air connections at various points so that they may be blown out if the lines are plugged with sludge. Separating sumps should be placed close to the treating plant to collect the drainage from the system. A great deal of light distillate can thus be recovered. It is advisable to neutralize the sludge acid with spent caustic if no acid recovery system is used. This will neutralize the acid in part and give better disposal conditions.

Standard pipe is used. Corrosion-resistant, lead-lined pipe in standard sizes is now being made and should be

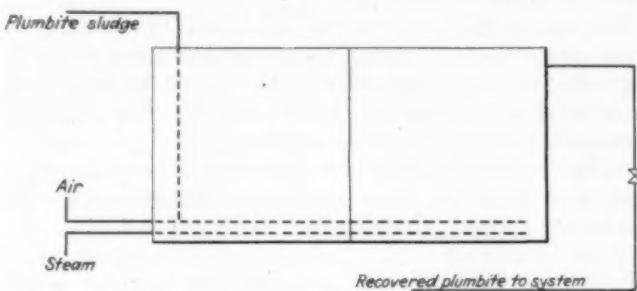


Fig. 19—Plumbite Recovery System

tinuously recirculated through the baffled coil. When no fresh caustic or plumbite as determined by tests is needed for any given period, circulation is maintained through the orifice column.

The oil overflows into the water-wash chamber where a continuous spray of water is discharged through it, maintaining a level of water in the sight-glass. The oil is next discharged to the horizontal orifice tube. This tube is connected with two pumps for acid feed and one pump is so regulated to feed from 1 to 2 lb. of acid into the short horizontal tube and the other to feed approximately 5 to 6 lb. of acid into the line leaving this horizontal tube and entering the orifice mixing column for the main acid.

The acid sludge and oil continue through the baffled mixing column and are discharged into the bottom of the acid-settling chamber. The sludge may be recirculated in part and drawn off in part. The acid-treated oil overflows into the water-wash chamber, which is lead-lined. It is desirable to have a sampling tube upon this overflow line in order to make sure that no acid sludge is discharging into the water-wash chamber.

The acid-treated and water-washed oil is next passed into the plumbite mixing orifice-column and the baffled column, which are arranged similarly to the preliminary plumbite or caustic mixing columns. The oil and plumbite are finally discharged into the plumbite-settling chamber, the plumbite is recirculated, and the oil is overflowed to storage.

*Gasoline Treating Plant:* The gasoline from the rerun still is treated in a plant of similar design to that shown in Fig. 17, according to step 8. This plant is designed to take care of 100 bbl. per hr. The caustic-mixing orifice column is of the same design as the plumbite columns, giving a back pressure (pressure drop) of 15 lb. at the above capacity. The settling tank is likewise of the same dimensions.

In operating this plant, the gasoline is pumped into the orifice column together with the caustic, discharged into the combined water-wash and settling chamber, sprayed continuously with water, and finally overflowed to the storage tanks.

In the design of plants for greater capacity, the dimen-

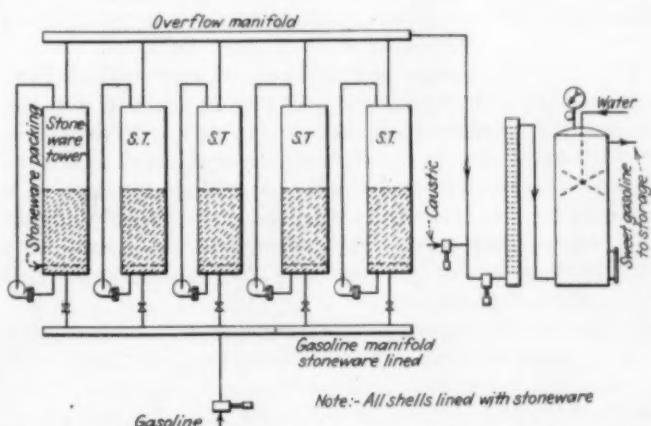


Fig. 20—Gasoline Treating System Designed for Reagents Which Corrode Ordinary Metals, e.g. Cupric Chloride

used on the acid-wash tank. Chromium alloys are also suitable. The average velocity through the pipe lines should be from 3 to 5 ft. per second.

While each settling chamber is shown equipped with a pressure gage, it is sufficient to have each alternate chamber so equipped. Each chamber must, however, be equipped with a venting arrangement shown in the drawing (Fig. 18) as a valve, which is preferably of the pressure-vacuum type.

Storage tanks should be provided for the acid, caustic, and plumbite solutions. For the last, two tanks should be provided, one for preparing the plumbite solution and the other for recovering the plumbite sludge (see Fig. 19). These tanks should be equipped with perforated steam-coils and perforated air lines for mixing and for recovering products.

Two mixing tanks for caustic and doctor solutions and the tank for recovering spent doctor may be made 5 ft. square and 4 ft. high. The tank for recovered doctor solution should be placed on the ground so the solution can gravitate into it from the agitator. The mixing tanks should be set high enough above the ground so that the solutions can be run by gravity into their respective blow cases. An "I" beam trolley and walkway should

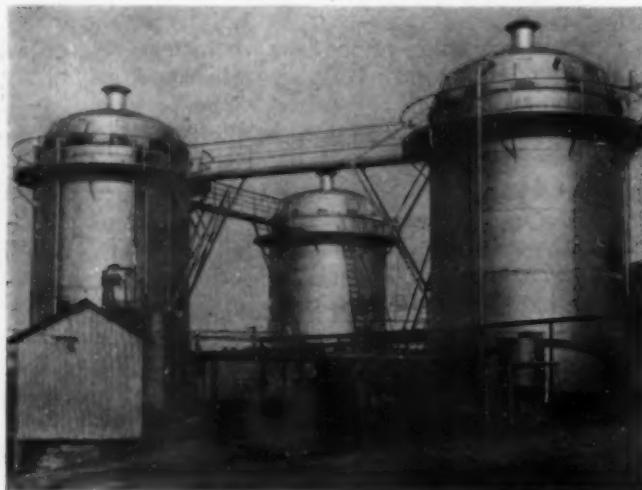


Fig. 21—Group of Three Batch Agitators

be built above the solution tanks to facilitate the lifting and handling of drums of caustic soda, and the like. Water and steam lines should be provided for both of these tanks, and either a small pump or an air or steam siphon should be installed for raising the spent plumbite solution to the mixing tank after the sludge has settled out.

**T**HE acid storage tank should also be placed high enough so that the acid will run by gravity into the blow case. Ordinarily the acid sludge is not recovered in a small plant, but is run to a sludge-acid pond. If a recovery system is used for acid, an acid-sludge tank may be included. In some refineries, this sludge acid is diluted with water and run to the sewer, but this practice is usually stopped by governmental authorities because of the pollution of streams.

A separating sump should be made of concrete with two or three vertical baffles for separating oil from wash water, sludge, and tar discharged from the agitator. This sump should be about 4 or 5 ft. wide, 3 or 4 ft. deep, and about 12 or 15 ft. long. A small sump should be placed alongside with a swinging suction-line, enabling it to skim

oil off the top of the sump compartments. This sump should be surrounded with a railing.

**I**N TREATING pressure distillate, an average of 12 deg. Bé. plumbite will be used. This is prepared by making up the caustic to the desired gravity and adding approximately 3 lb. of litharge per bbl. of caustic while the latter is hot and is undergoing agitation. For the split plumbite treatment stronger solutions are used prior to the acid treatment, e.g., 25 deg. Bé. gravity, in which case approximately 6 lb. of litharge per bbl. of caustic soda solution is used.

Plumbite sludges may be recovered by blowing the precipitate formed during the treatment with air in the presence of caustic solution. This should be done, preferably, at a temperature of 150 deg. F. Fig. 19 shows equipment suitable for this purpose.

The foundation should be high enough to permit channels for the drain pipes and allow replacements. The tanks are skirted and bolted to the foundations.

The photographs in this article show a group of three batch agitators, and a continuous treating system. These plants were built several years ago, and are shown to illustrate the appearance of the equipment at the refinery.

Where it is desirable to heat or cool the reagent and oil in order to modify or control the reaction, heat exchangers or refrigerators may be used preceding the mixing elements.

Fig. 20 is a design of equipment for the treatment of distillates with substances which corrode lead as well as steel, such as dilute acids or salts which form dilute acids upon hydrolysis, or where electrolysis will occur. Such reagents are not used in general practice, but their use is expected and hence a design has been prepared. Of course such equipment could be made of special alloys, but the cost might be prohibitive. The arrangement would be the same as that shown in the diagram, however.

**A**GASOLINE or distillate manifold line, stoneware-lined, is connected to the scrubbing tanks also made of stoneware, packed with gravel, crushed rock or some sort of ceramic packing. Each settling tank is equipped with a recirculating pump which may be of a corrosion-resistant metal or alloy or lined with hard rubber. The various scrubbing tanks are operated in parallel, the gasoline being continuously recirculated through the reagent distributed through the scrubbing material. The reagent is filled to one-third or one-half the height of the tower so as to provide settling time for the removal of the gasoline before it enters the overflow manifold. The inflow manifold may be raised above the level of the reagent and hence can be made of ordinary material, although the lines leading to the scrubbing tanks which are below the level of the reagent should be of corrosion resistant material.

The gasoline or distillate is picked up by a separate pump and is mixed with caustic soda solution to neutralize the excess reagent before passing into the orifice column, finally overflowing into a tank for a final water-washing.

In concluding this series of articles the authors would again call attention to the fact that the chemical treatment of petroleum distillates involves basic chemical engineering principles. Proper attention to these will insure simplified and efficient operation.

# Chemical Engineering May Revive Sublimation of Sulphur

*By E. F. White*

Consulting Engineer, Rutherford, N. J.

SULPHUR, the magic "burning stone" of the ancients, was one of the earliest of elements to be recognized as a chemical entity. For many centuries its extraction consisted in the melting out of surface deposits to form the brimstone which found its way into the alchemist's retort. Until 1902, when the Union Sulphur Company opened the Louisiana field with the Frasch process, the production of sulphur had hardly progressed beyond its original elementary stage. It was, however, recognized at least as early as four centuries ago that a sublimation process—actually a distillation—could be employed to produce sulphur of great purity. Later discoveries showed that certain additional advantages accrued to the user of the sublimed product, "flowers," by reason, perhaps, of its fineness.

This brought about a series of subliming processes which gradually evolved into the brick subliming chambers of the present day. Sulphur was melted and boiled in iron retorts which yielded the vapors to large brick chambers, where the product gradually condensed and settled to the floor and walls. That nearest the retort formed a pool of molten sulphur which, in some of the more modern installations, was run out continuously and cast into sticks. In others, it was allowed to solidify as the chamber cooled after a run and was removed by pick and shovel when the chamber was opened. This was then remelted and cast into sticks or "rolls," as the rhombic sulphur of commerce.

As the distance of the settled sulphur from the retort increased, its fineness likewise increased, producing a number of separable grades, roughly characterized as heavy and fine flowers. The flowers was classed as sulphur bulking more than 74 deg. Chancel (a measure of fineness. See Wyld's Lunge, vol. 1, p. 51) and containing more than 30 per cent of amorphous particles.

The sublimation chambers were operated continuously until their condensing capacity was reached, when operation ceased, the seal was broken and laborers entered to remove the refined products.

Meanwhile, it was discovered that the use of inert atmospheres in connection with the grinding of sulphur greatly decreased the danger of this formerly hazardous operation. It was also found that ground crude sulphur was not necessarily inferior to flowers for some uses. As the price of crude advanced during the last ten years, this advance, coupled with the relatively low cost of operation of grinding equipment and the low capital investment for the latter, far smaller than that required for a sublimation plant, co-operated to force sublimed flowers from the market almost completely.

However, there were indications that the change was not entirely for the better. Tests have demonstrated that the use of flowers in rubber vulcanization gives a product



Fig. 1—Top of Retort and Gas Generator Showing Melting Pan and Vapor Neck

The chamber and the auxiliary equipment appear in the background. The latter consists of the  $\text{CO}_2$  recorder, dust collector, desiccator and gas circulating blower.

with somewhat higher tensile strength and elongation than may be obtained using ground crude. This is believed to be due to the better dispersion of flowers in the rubber mix. Studies in connection with insecticides show that the toxicity of the minute spherical particles of flowers is considerably greater than that of either ground refined or crude sulphur. The explanation of this statement is not known, but its truth is borne out by much evidence. (*Chem. & Met.*, vol. 31, No. 4, p. 147ff.) Similarly, agricultural experiments have shown that any form of finely divided sulphur is not only capable of producing almost unbelievable improvement in many soils but that there again experiment favors flowers.

It was with these thoughts in mind that the author attempted the modernization of the sublimation process, with a view to developing a product which could compete successfully on a price basis with ground crude, and which could be made with almost a total elimination of the explosion hazard. It is believed that the pilot plant, to be described, furnishes an affirmative answer to the question of whether flowers can ever again be a factor in the market. While it must be remembered that the experiments were carried out only on a comparatively small scale and that operating costs were therefore not as favorable as could be expected from a larger plant, nevertheless, it was found that production costs were little, if any, higher than those for grinding. In addition, the hazard was reduced almost to the vanishing point.

The old sublimation system relied upon the burning of a part of the sulphur processed to supply an inert atmosphere of nitrogen and sulphur dioxide. It relied upon its heavy brick walls to remove the heat of vaporiza-

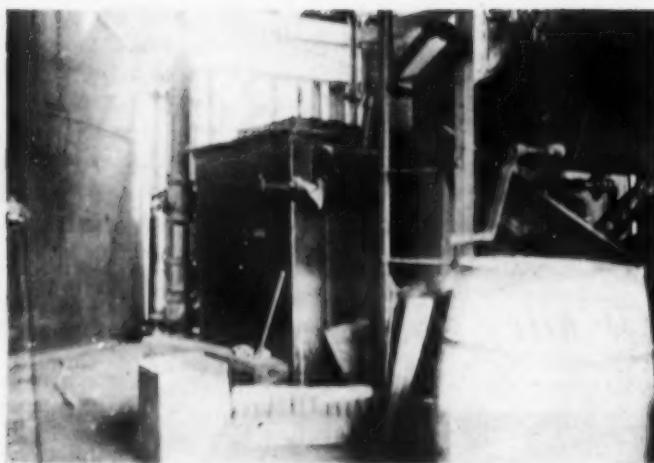


Fig. 2—Retort, Roll Sulphur Draw-Off and Conveyor for Finished Flowers

tion of the sulphur mist and bring about condensation. And finally, quiescent conditions and unhindered settling prevailed, with the result that relatively great volume was necessary and the grading left much to be desired.

The new system, upon which there are now patents pending, reverses most of the old procedure, with the result that the capital investment is cut to less than one-third of that for brick chambers, cubic content is reduced to less than one-sixth, labor is but a fraction, the process is entirely continuous, control is automatic and the product is practically uncontaminated with acids. The combination of moisture and an atmosphere of sulphur dioxide in the brick chamber process made "sour," that is, more or less acid sulphur, the rule.

Where the old system employed brick chambers, the new uses protected sheet iron. Where unhindered settling prevailed before, now many collecting surfaces are provided to arrest the quickly condensed sulphur dust; where SO<sub>2</sub> served as the atmosphere, now a mixture of CO<sub>2</sub> and nitrogen is used; where before, the vapor drifted aimlessly through the chambers, now a continuous circulation of the inert atmosphere insures speedy removal of the sublimate from the retort and deposition on the surfaces. A dumping feature in connection with the latter permits a discharge of the flowers, graded in fineness with distance from the retort, to a series of hoppers in the chamber. Thus, the various grades are mechanically separated and discharged by conveyors into separate receivers without the necessity for either opening the apparatus or ceasing operation. The 25 per cent of time lost for cleaning is a thing of the past.

Provision is likewise made for continuous removal of the molten sulphur entrained with the vapors. In the brick chambers this collected on the floor, seriously interfering with the deposited flowers and in some plants requiring the use of a pick for its removal. Now, by the use of a baffle, suitably located, this entrainment is separated from the vapor stream, either to be returned to the retort for revaporation in case the product is to be entirely flowers, or to be cast continuously into sticks.

The apparatus used consists of a retort and melting pan, fired by a furnace in which is incorporated a pre-heater for the combustion air. This feature makes for high efficiency in fuel utilization, with flue gas at a temperature only slightly above that of molten sulphur. The sulphur is supplied continuously to the melting pan which is placed in the retort setting. There it melts and flows through a liquid seal into the retort, maintain-

ing a constant level as the sulphur in the retort is vaporized. Flue gas from the burner heats the retort, the melting pan, and finally the air passing through the pre-heater, issuing from the retort setting either to the atmosphere or to a gas bell to be held in reserve for use in the chamber. Losses from gas leakage require the addition of about 3 cu.ft. of the inert gas from the gas holder to the circulating atmosphere per lb. of sulphur sublimed. This circulating atmosphere is handled by means of a small blower which maintains a pressure of  $\frac{1}{2}$  in. of water in the chamber. Suitable regulating valves control this pressure, preventing any air infiltration into the system. The inert gas passes through the blower and is injected into the retort at a pressure of 5 in. and into the neck connecting the retort and chamber, where it assists materially in conveying the vapor. Gas leaving the chamber passes through a dust collector, then through a desiccator for moisture removal and back to the blower.

The chamber in this case was cylindrical. In larger installations it would be made rectangular or divided between a number of smaller cylindrical units for ease in construction. Chamber temperature averaged only 105 deg. F., proving the efficacy of sheet iron construction. It was found that a volume of 10 cu.ft. per lb. of sublimation per hour was ample.

In regard to the products, it was found the flowers produced averaged over 97 per cent through 200 mesh. Ultimate particle size averaged about 0.008 mm. Total acidity was negligible. Roll sulphur production could be controlled to yield this product in any proportion.

In comparison with crude sulphur grinding, it appears that the capital expenditure ratio is about four to one in favor of grinding. However, maintenance and depreciation are small with the iron chamber system, whereas they are relatively high in grinding. Even with the use of an inert atmosphere in the latter, an appreciable hazard remains, with its resultant possibility that the entire installation may be wiped out at a single stroke. The iron chamber system, on the other hand, is substantially fool-proof. At the same time, labor costs are comparable, although it is believed that a larger installation would show in favor of the sublimation system. Power costs for grinding are considerably above the total costs for fuel and power for the chamber process, except where very cheap electricity is available. Hence, in summary, it appears that even with the disproportionately high manufacturing cost entailed in a pilot plant, that there is but slight advantage for grinding which is offset in the writer's opinion by the added value of flowers.

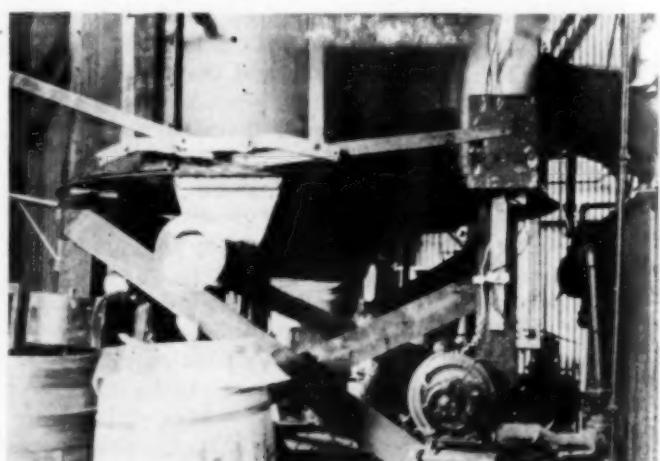


Fig. 3—Chamber, Dumper for Settling Surfaces and Discharge for Finished Flowers

# Fundamental Principles in the Design of Gas Burning Equipment

*By N. T. Branche*

Surface Combustion Company, Toledo, Ohio

TODAY's competition of fuels for industrial heating operations and the additional accuracy with which these operations are now being controlled in industries which utilize heat, have contributed largely in the last decade to the perfection which present day gas burning equipment has attained. Where formerly the use of pipe nipples fitted loosely into the walls of a furnace to serve as burners was considered standard practice, today the accuracy of the furnace operation as a whole is so closely estimated and maintained that it has become necessary to use the same precise workmanship for burner equipment as applies to any other well designed machine.

The present paper deals not only with the burner proper but also with its proportioning device. Chief among the proportioning devices which are in use today are those utilizing one of the necessary elements of the combustion, air or gas, to entrain the other element. It is well known that if a venturi throat is designed correctly, the conversion of pressure to velocity may be accomplished with an efficiency as high as 90 to 98 per cent and that subsequent conversion of velocity to pressure may be accomplished with substantially the same efficiency. In view of these high efficiencies and the fact that with high gas velocities, pressures in the contracted throat section of the venturi, well below atmospheric pressure may be attained, we have a means of drawing in or inspiriting one fluid in a proportion depending upon the supply of the other, by providing the other fluid under pressure. The construction of these venturi types of inspirators calls for extreme care in aligning the various parts to insure their co-axiality. Any divergence of the stream results in eddy currents and consequent loss in burner pressure or in poor proportioning. The more efficient inspirators are machined internally for smoothness and accuracy to minimize the friction losses and to retain as much of the initial energy as possible in the form of burner pressure at the flame nozzles.

WHEN gas is used to entrain air required for combustion, the combustible mixture supplied must be under sufficient pressure at the burner nozzles to have a higher velocity than the rate of flame propagation. Should the velocity be less than the rate of propagation, a flash-back occurs, igniting all of the mixture stored in the manifold piping between the inspirator or mixer and the burner. The minimum velocity allowable, therefore, will vary for different gases because of their different rates of flame propagation. Thus, with coke oven gas high in hydrogen content, we find from experience that pressures much below 0.5 in. of water pressure through the burner nozzle are apt to permit a flash-back, for the velocity of flame propagation of such a mixture is 30 ft.

per second. On the other hand, with natural gas, we have a rate of flame propagation of 14 ft. per second which permits mixture pressures as low as 0.2 in. of water.

From the foregoing, it appears that the lower limit of the turndown capacity is governed by the characteristic of the particular gas in use. The upper limit in rate of gas used, of course, is set by commercial limitations on the pressure which it is expedient to apply to the gas in order to entrain the air.

As the mixture pressure controls the velocity, it is apparent that the quantity of gas which flows varies directly as the square root of the pressure. It is evident that the mixture pressure must be increased more than in proportion to capacity increase for higher rates of gas flow. This will be apparent from an inspection of Fig. 1. It will be seen that, for example, four times the burner pressure will result in a doubling of the gas flow. An inspection of the curve for artificial gas on Fig. 2 shows that for a 10-lb. initial gas pressure the mixture pressure will be about 4 in. of water. Referring to Fig. 1, we see that the maximum gas consumption for a

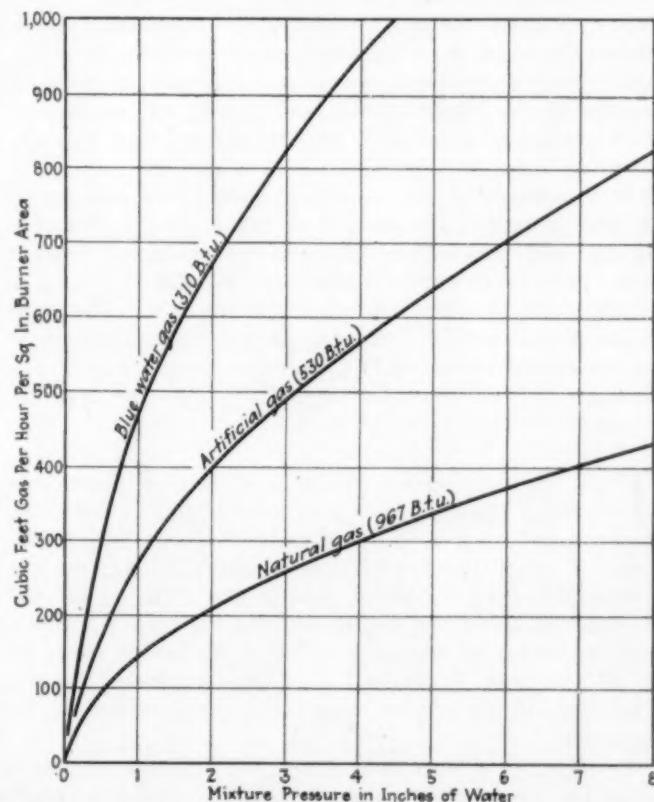


Fig. 1—Gas Discharge per Square Inch of Burner Nozzle Area for Various Types of Gas at Various Pressures of the Air-Gas Mixture

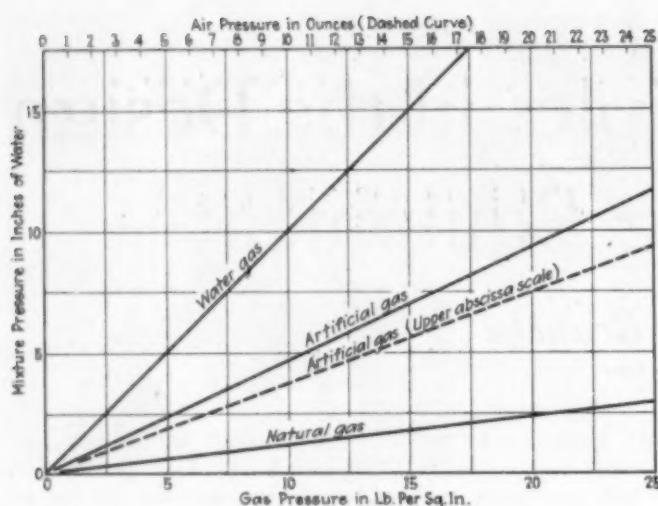


Fig. 2—Air-Gas Mixture Pressures Attainable with Various Gases at Various Gas Line Pressures

The broken curve used with the upper abscissa scale, refers to gas inspirated by air. The solid curves represent the reverse case of air inspirated by gas.

burner of 1 sq.in. flame port area will be 570 cu.ft. of gas per hour. And with a minimum turndown pressure of  $\frac{1}{2}$  in. of water at the nozzle, the minimum consumption will be 165 cu.ft. per hour or a ratio of 3.46 to 1 between maximum and minimum rates of gas flow.

In the case of natural gas, the mixture pressures produced in a burner are relatively considerably less than for artificial gas as it is necessary to inspirate nine to ten cubic feet of air per cubic foot of gas to secure complete combustion. This is about twice the air required for artificial gas. It is therefore customary to increase natural gas pressure to 20 lb. or more. The use of Figs. 1 and 2 together will give a clear idea of what may be expected in capacities per square inch of burner area for the various gases when properly mixed with the required amount of air. It should be noted that these curves are based upon installations of medium size. On small inspirators, these pressures are somewhat reduced because of the increased ratio of venturi wall surface to cross sectional area with consequent greater friction losses.

In the design of the inspirator proper, the gas nozzle or spud is usually constructed of brass. It consists of a conical inlet terminating in a channel orifice of definite area. The co-efficient of discharge of such a spud, if carefully machined, will be about 98 per cent. The spud is removable, and by increasing or decreasing the orifice, the mixture may be varied to contain excess air for combustion or insufficient air depending upon the type of furnace atmosphere required.

THE venturi consists of an inlet with a flared entrance, a throat of definite diameter and an outlet or pressure cone for re-converting the velocity into pressure. Venturi throats are often of special shape, several types of which are now in general use. The more efficient a venturi is, the higher, usually the ratio of throat area to burner nozzle area. This ratio varies from 43 to 53 per cent, dependent upon the particular design. This ratio is the critical point in the functioning of an inspirator.

In order to determine a given burner area, the heat input for the operation under consideration is calculated. Use of Figs. 1 and 2 permits determination of the flame nozzle area for any available gas pressure. When the

characteristics of the venturi are known, the burner area then sets the venturi throat area at somewhere between 43 and 53 per cent of the former. The orifice size of the spud itself must be determined by trial to give the desired ratio of air and gas to produce the desired furnace atmosphere. This, of course, is regulated by flue gas analysis.

Where air is used to inject the gas, it is necessary to reduce the gas to atmospheric pressure if entrainment is to be strictly a function of the air supply. This is accomplished by means of a pressure regulator or governor. If the same type of inspirator described above is used, it will be found that the proportion of throat area to burner area will not change materially although the percentage will be reduced slightly. However, the size of the spud

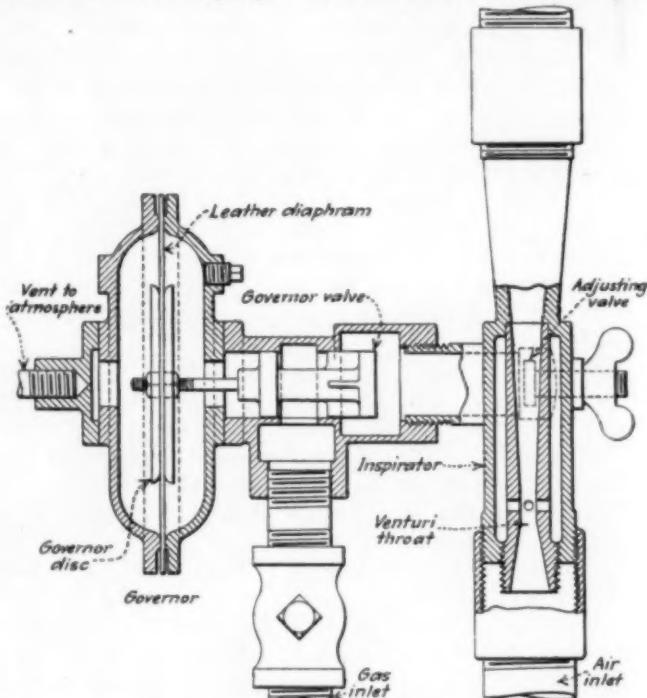


Fig. 3—Sectional Detail of a Proportioner with Governor for Inspiring Gas with Air under Pressure

must be increased greatly due to the fact that it is now the air instead of the gas which is to be metered. For example, in the case of artificial gas of 530 B.t.u., five parts of air must be supplied for one of gas. Accordingly, the mixture pressure would be higher due to the increased volume under pressure if the air pressure should be maintained at that required for gas in the reverse case. However, compressing such a large volume of air has no particular benefit since, as has been noted, the capacity does not increase directly in proportion with the pressure but rather as the square root. It is therefore customary to use pressures of one to two lb. for the air and to utilize a centrifugal fan or positive displacement blower for the air supply. A burner pressure of about 6 in. of water will result on the average from 1 lb. of air pressure, as compared with 4 in. for 10 lb. of gas pressure. The broken curve in Fig. 2, used with the upper abscissa scale, shows the results that may be expected in using artificial gas, entrained by the air.

When using air to entrain the gas the venturi must, of necessity, be of an inclosed design to which the gas may be conducted. It is possible to utilize a venturi throat alone, through which the air passes, inspiriting the gas through openings at the end of the constricted section rather than by use of a venturi and spud.

Such a proportioner is shown in Fig. 3. A number of combinations of orifices and venturii are used, whereby the drop in air pressure actuates a governor which discharges gas into a low pressure zone in the air stream. Such inspirators utilize low pressure air and inject the gas into the manifold under some pressure. Fig. 4 illustrates a number of types of inspirators for proportioning air and gas. (a) and (b) typify inspirators which draw air into the gas, while (c) represents another type for inspiriting gas with air.

When the gas is passed through a correctly designed inspirator, it is thoroughly mixed with the air and correctly proportioned. It discharges from the inspirator into a manifold pipe which supplies several burners on the furnace. The manifold pipes should be large enough in cross section to reduce pipe friction but the flame nozzles themselves must increase the velocity of gas flow to prevent a flash-back of the burning mixture. These nozzles therefore always aggregate much less in area than the pipe conducting the mixture to them. The burner nozzles themselves will show a coefficient of discharge dependent upon the shape of the inlet end. Those with a conical tapered entrance will give the highest efficiency.

The burner proper must be shielded from the furnace heat by suitable refractory protection. Burners must be maintained at a low temperature for two reasons. In the first place the heating of the unburned mixture promotes flash-back and secondly, preheating of the mixture will cause the proportioning to vary due to change in gas density. For this reason, air-cooling fins are cast on burners of the smaller sizes while water-cooled nozzles

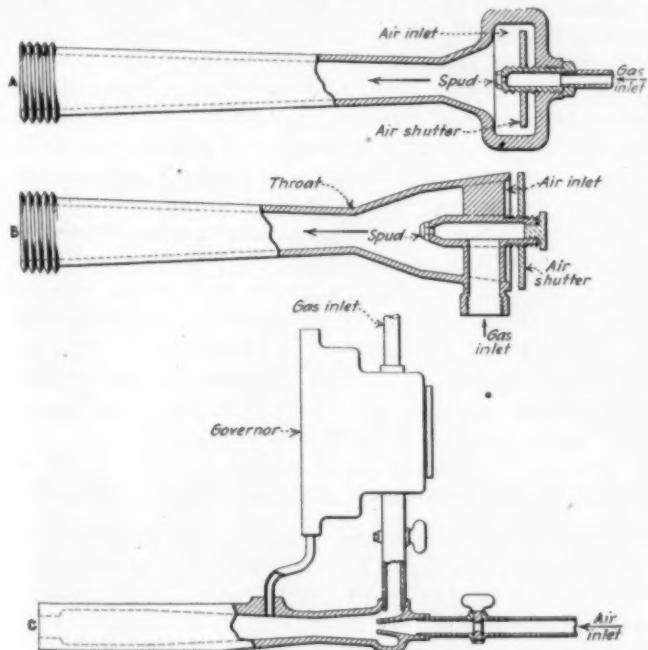


Fig. 4—Three Types of Proportioners for Gas and Air  
(a) and (b) use gas under pressure while (c) is of the type in which the air is used to entrain the gas.

are used in the larger installations to accomplish this purpose.

As it has been previously stated the ratio of throat area of venturi to burner flame port area is the controlling factor in proportioning gas and air over the range of turndown. It is therefore important that all manifold piping be of ample size with a minimum of bends to prevent friction in these pipes from affecting the proportioning. Similarly it is necessary that the burner area

be held constant and that no valves or restrictions be inserted between the inspirator and burner nozzles. Any burning away of the nozzles should be corrected to give the original diameter. Otherwise, correct furnace atmospheres cannot be maintained. When the mixture issues from the nozzle, its velocity immediately decreases and expansion takes place. Combustion ensues and it will be accelerated if incandescent refractory surfaces are supplied at this point to catalyze the combustion reaction. These surfaces also have a tendency to localize combustion near the point of issuance from the nozzle. A burner adapted to such surface combustion is shown in Fig. 5. If such surfaces are absent or cold surfaces are interposed near these points of issuance, the reaction is retarded and may result in a final furnace atmosphere containing both unburned carbon monoxide and free oxygen. This condition, which may seem impossible at first glance, is probably due to the dilution and cooling of the two reacting gases by the great volume of inerts—water, nitrogen and carbon dioxide which are present.

OUTLET from the burner is arranged so that the gases may be controlled in direction and velocity. A turbulent, swirling effect and rapid intermingling of the newly burned gases with those of the furnace atmosphere tend to distribute the heat and give uniform temperature throughout the furnace chamber. This, however, is not always desired as there are cases where a fast localized heating is the requisite.

It is frequently the case that special burners are designed for particular applications which require different combustion characteristics from those obtained with the ordinary sharp combustion of a pre-mixture of air and gas. For example, in baking, roasting and similar operations, it is desirable to have a maximum amount of radiant heat and a minimum of sensible heat in the flue gases. This may be accomplished with a burner of special construction utilizing a porous refractory diaphragm. Such a burner is shown in Fig. 6. The pre-mixed air and gas for this burner are fed into a box-like container behind the diaphragm. The mixture passes through the pores of the diaphragm and discharges at low velocity into the valleys in the grooves on the face. Combustion takes place in a thread-like line in each valley until the peaks become incandescent. At this time the flame entirely disappears due to the localization of the combustion on the hot surfaces, and the plate glows as though heated from beneath.

Another case where a special burner is required is that in which it is important for the flue gases to be kept as low and uniform in temperature as possible to prevent

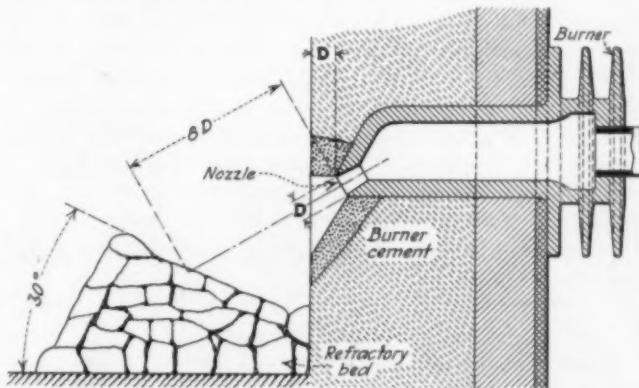
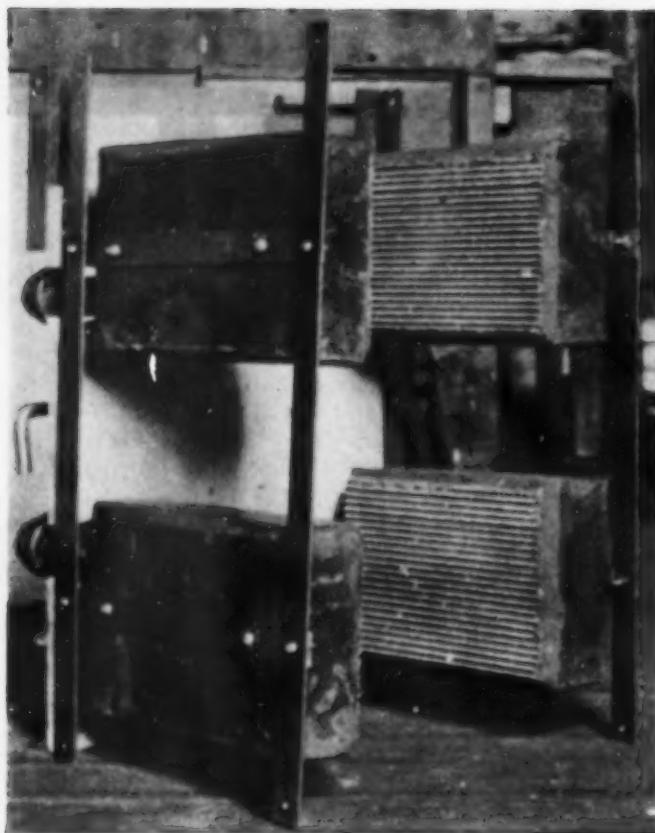


Fig. 5—A Fin-Cooled Burner Nozzle for Use with Incandescent Surfaces to Catalyze Combustion



**Fig. 6—A Radiant Heat Burner Which Uses a Corrugated Porous Refractory Diaphragm in Place of the Usual Nozzle**

excessive heating of the product at the point of combustion. This is accomplished by means of delayed combustion with only 50 per cent of the air admitted to the proportioning device. The remainder is supplied at the point of combustion from a separate source. An example of this application is that of an asphalt heater in which an emersion burner is used. It is imperative that no excessive temperature be built up because of the tendency of the asphalt to coke on the immersed pipe.

As was previously pointed out, the ratio of turndown on high pressure equipment is ordinarily limited to about three to one unless excessively high gas pressures are used. This is a decided handicap where a furnace is required to have great flexibility in operating temperatures or where the control is to be handled automatically by a temperature controlled instrument. Ordinarily, with manual control, two inspirators and manifolds may be installed, thus permitting the use of both for quick heating or where a large amount of gas must be burned, and the use of only one when holding a temperature already attained. Such an arrangement, however, is not easily adaptable to the use of automatically controlled instruments in that a complicated arrangement of dual valves is required. In addition, on the high-pressure type of inspirator, the air shutter must be closed before shutting off the gas to prevent a flash-back of the mixture remaining in the manifold. This mixture often amounts to a considerable quantity in installations where the manifold volume is large.

**I**N such a case equipment of the type known as a velocity burner is used. This is a modification of the type in which gas entrains the air. A spud discharges high pressure gas to a small venturi tube, inspiring only one-half of the air for combustion. This nozzle in turn

discharges into a second burner nozzle which terminates in a refractory tunnel in the furnace wall. Here the remainder of the air is inspirated. The mixture which issues from the first nozzle is so deficient in air that it is impossible for combustion to flash back to the spud even at extremely low pressures. For this reason such a burner has a turndown ratio of from 10 lb. to 2 in. of water pressure. This ratio is approximately 10 to 1 in capacity and gives ample range for fully automatic control. Throughout the entire range the correct proportions are maintained. When automatic control is to be used with this type of inspirator, a usual arrangement consists in supplying a single motor operated valve in the gas line which may be controlled between fully opened and closed limits by means of the temperature controlling instrument. A by-pass around the valve keeps the burner in operation at very low capacity when the valve is closed. The temperature is thus regulated by duration of the period in which the valve is fully opened and may be maintained within a few degrees of an average.

### Algin Now Produced Commercially

In or about 1880 the Scottish chemist, Sanford, isolated from kelp, a product which he called algin or alginic acid. While the acid defied his, as well as all subsequent efforts at determining its composition, it was nevertheless found to be an organic acid, stronger than acetic acid, yielding salts with valuable colloidal properties. The salts of sodium, ammonium, potassium and magnesium are soluble in water while those of other bases are insoluble although most of them form soluble salts with ammonia.

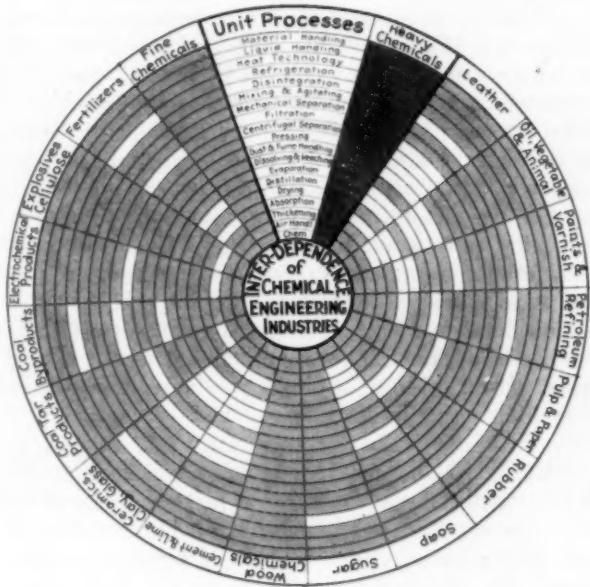
The commercial applicability of the alginates lies in their relatively high viscosity in solution. Less than four per cent of an alginate in solution is usually suitable to serve as a binder for fibers; as an emulsifying agent for oils, fats or waxes; for producing soluble or insoluble coatings; as a size; as a dispersing agent or as a stabilizer for such products as ice cream and food jells. Different grades, varying from a crude to a pure, bleached form have recently been made available for various uses by Thornley and Company, San Diego, Calif., who are reported to be first to produce alginates commercially in a pure form.

### Effect of the Repeated Reclamation of Rubber

George W. Miller, at the recent St. Louis meeting of the American Chemical Society, answered the question "Can rubber be repeatedly reclaimed without seriously affecting the quality of the reclaim?" To throw some light on this point, a sample of whole tire reclaim was cured, then regenerated in a laboratory devulcanizer and the cycle repeated three times. While repeated reclaiming had no effect on the tensile of the resulting reclaim, the modulus increased and elongation decreased with each successive cycle. The chloroform extract and plasticity decreased with an accompanying increase in combined sulphur. The successive reclaims, incorporated in a low quality tread compound, imparted progressively decreasing elongation and tensile, with increasing modulus. Contrary to expectation, there was no increasing deterioration of aging properties, as far as could be judged by artificial aging.

# *Basic Nature of HEAVY CHEMICAL Industry*

## *Insures Constant Opportunity for Engineering Progress*



THE PRODUCTION of heavy chemicals, consisting, as it does, of the application of practically all the unit processes to basic chemical reactions, depends primarily on the chemical engineer for its success. This dependence begins with the development of the raw materials of the industry, most of which are the products of chemical engineering processes, and is emphasized by the interdependence of the heavy chemical industry and the industries of the chemical engineering group. According to *Chem. and Met.*, seventy-five per cent of the domestic consumption of heavy chemicals is accounted for by this group, and, naturally, the satisfaction of the requirements of his principal customer is a matter of first importance to the heavy chemical manufacturer. This inter-relation has brought about the establishment in the sales group of the chemical engineer, whose technical knowledge and abilities are directed toward the correlation of products and processes of the producer and consumer to the furtherance of their mutual interests.

Sulphuric acid is the product of primary importance to the heavy chemical manufacturer, inasmuch as it serves as a raw material for the production of the other heavy chemicals. The problems of the chemical engineer in this field are complicated today by the return to favor of iron pyrites as a source of burner gas, the present high price of sulphur making its use economically impossible for many manufacturers.

Much of the progress made in the production of contact sulphuric acid has been due to the use of sulphur. Its

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properties make it an ideal source of sulphur dioxide. It is readily burned, has a low content of ash, and produces a dust-free, arsenic-free burner gas. Its production in quantity as a result of the Frasch process, a classic development in material handling, was followed by its substitution for pyrites in the sulphuric acid industry, with consequent simplification of the problems of combustion and purification, and decrease in capital outlay and operating costs. Expensive pyrites burners were replaced by the relatively inexpensive and readily controlled rotary burners. Dust settling chambers and scrubbers were eliminated, and the all-iron purification system was introduced, the gas being cooled and dried by 98 per cent acid sprayed into empty iron towers. The consequent decrease in resistance to gas flow brought about the replacement of the high-speed centrifugal blower, steam turbine driven, by the low speed, electrically driven, Roots type. The recent development of the spray burning of sulphur, makes unnecessary the filters for acid mist removal. This process readily permits the predrying of the air used for combustion with consequent prevention of the formation of acid mist. One plant utilizing this process is already in operation and will be the object of interested observation on the part of the industry.

PRESENT-DAY return to pyrites places on the chemical engineer the burden of maintaining the ground gained by the use of sulphur. The burning of the ore is at present an empirical process. An increase in our knowledge of the facts of this fundamental operation will be undoubtedly followed by an improvement in methods. An improved source of raw material is available, the very fine product resulting from the concentration of copper ores by the double flotation process. These fines have a sulphur content averaging 50 per cent or better, are low in copper and arsenic, practically free from lead and zinc, and burn to an ash of comparatively low sulphur content. However, they complicate the problems of combustion and dust elimination, in that they burn rapidly with consequent concentration of the heat evolved on very few shelves, and have a dust loss as high as 5 per cent of the charge. The present Herreshoff burner, the type in general use, is an improved type, capable of speeds up to 10 r.p.m. The use of rabbles made of high temperature alloys such as Fahrite,

is being considered, inasmuch as the cast-iron type, now in use, wear out rapidly. Close control of temperature throughout the burner, which is necessary to prevent slagging, is facilitated by the installation of pyrometers on every shelf. The disposal of the pyrites cinder, amounting to approximately two-thirds of the weight of the charge, now makes copper leaching and sintering processes necessary adjuncts to the acid plant. Improved methods, developments of the metallurgical industry, are available.

**F**OR dust removal, the electrical precipitator, and one of the centrifugal type are replacing the relatively inefficient dust chamber and its attendant scrub towers. The characteristics of the electrical precipitator are well-known. Efficiencies of 95 to 99 per cent are reported. The centrifugal separator, a new development, is an outgrowth of power house practice, having been originally designed for the removal of fly-ash from stack gases. It has a relatively high power consumption, offset, however, by its low first cost and simple construction. Efficiencies of better than 90 per cent have been obtained. These separators are an improvement over the old dust chamber, but inasmuch as both types of separator work on an efficiency basis, regardless of load, the satisfactory removal of dust is still dependent on the operation of the burner. The removal of lead sulphate fume is still a problem with ores of high lead content.

The rest of the purification system presents no new problems. The present coke filters for the removal of acid mist are highly satisfactory and are expected to operate as successively on pyrites as on sulphur. The apparatus available for the drying of the burner gases is limited to the packed lead tower, inasmuch as the dry towers must follow the coke filter in the system, to prevent the possible contamination of the dry tower acid by dust and arsenic. This eliminates the spray tower, with its possible high entrainment losses, and makes problematical the use of 98 per cent acid and iron apparatus on account of a possible sulphuric acid vapor tension at summer temperatures.

**C**ONVERSION of  $\text{SO}_2$  to  $\text{SO}_3$  has been the subject of some very interesting recent developments. General practice is to carry out the reaction in two stages in Herreshoff plate converters, using a platinized asbestos contact mass. Catalysts of vanadium and a promoter metal which can be deposited on coarse carriers, such as quartz, are now on the market. It is claimed that these masses are not affected by poisons such as hydrochloric acid and arsenic, have a low gas resistance, and are just as active and cheaper than platinum. A converter, a modification of the old Tenteleff type, combines pre-heater and converter and carries out the whole reaction in a single piece of apparatus. The two vertical heat exchangers in common use have been combined with success into a single, horizontal exchanger, divided into two compartments. This permits a somewhat better rate of heat transfer and considerably simplifies the problem of retubing. The direct introduction of hot burner gases into the converter and subsequent cooling during conversion, with resultant increase in reaction rate and decrease in the amount of catalyst required, is of course, not possible with present pyrites practice. For manufacturers burning sulphur the development of a satisfactory converter for this process presents an interesting study in heat transfer, the principal problem involved. The spray burning of sulphur should lend itself

readily to this application after further development.

The absorption of the converted gases is readily accomplished by 98 per cent acid. The close control of the absorbing acid strength which is necessary, the allowable variation being 97.5 to 99 per cent, is facilitated by the conductivity method of analysis. The trombone type of cooler which is easily constructed and repaired is in general use for cooling the absorbing acid.

An interesting development, brought about by the demands of the trade, has been the production of 66 deg. Bé. battery acid. Steam or water and  $\text{SO}_3$  are mixed to form an acid mist of the required strength and this is condensed in a silica apparatus. The resulting acid is practically C.P.

Chamber plant capacities have been increased by the use of various processes for increasing the rate of reaction without the additional consumption of niter. Among these are the Mills-Packard system in which the chambers, built in the form of truncated cones, are cooled by a stream of water, running down the outside; the Gaillard system, which cools the inside of the chamber with dilute acid and disperses the acid throughout the gas as well; and various packed tower systems which bring the gas into intimate contact with niter acid. The use of niter pots is gradually giving way to the installation of ammonia oxidation units, insuring a more regular addition of nitrogen oxides to the set. However, the exact mechanism of the chamber reaction itself still remains more or less of a mystery and it is reasonable to suppose that additions to our fundamental knowledge will result in further progress.

**A**PROMISING possibility of the chamber process, that of the production of 66 deg. Bé. acid in the Glover tower, has not received much attention from chemical engineers. Glover acid of 66 deg. should be cheaper than 66 deg. contact acid, as the first cost of a chamber plant is certainly no more than that of a contact unit of the same capacity, its life is longer and repair and labor charges are lower. There is enough heat available in the burner gases, presupposing a reasonable coefficient of heat transfer in the Glover tower, to concentrate the acid made in the set to 66 deg. Bé. but this necessitates that no more than the equivalent make of the set be circulated over the Gay-Lussac, a relatively small amount for present tower design and practice. The problem, then, is really one of the absorption of nitrogen oxides in sulphuric acid.

The return to pyrites makes the continued usefulness of the chamber process problematical. The greater part of the acid produced today by the heavy chemical manufacturer must be low in iron and arsenic and such acid cannot be made in a chamber plant operating on pyrites, at least not by present methods.

The production of nitric acid and its related products, salt-cake and muriatic acid, is complicated by the development of cheap synthetic ammonia by the chemical engineer. The greater part of our muriatic acid and salt cake is produced by the interaction of salt and niter-cake, inasmuch as the relative consumption of the two products is better represented by the yields obtained from this reaction than from the reaction between salt and sulphuric acid. The production of nitric acid from ammonia results in no byproduct niter-cake and forces the utilization of salt and acid to supply the salt-cake demand, with a consequent excess production of hydrochloric acid for which there is no market at present. The course of the heavy chemical manufacturer and the

problems of the chemical engineer will be determined by the demands of the related industries.

The production of nitric acid from nitrate of soda is still carried out by the batch method, as no successful continuous process (a problem in material handling) has ever been developed. The development of chrome steel affords a means of improving equipment.

**N**ITRIC ACID from ammonia is a problem in absorption and heat transfer. The absorption of the nitrogen oxides in water is accompanied by a considerable evolution of heat and at ordinary pressures proceeds slowly with the production of comparatively weak acids which must be concentrated for most purposes. Absorption under pressure is much faster and results in a somewhat stronger acid, but has the disadvantage of materially decreasing the conversion efficiency.

The construction of hydrochloric acid absorption towers and their operation have been considerably improved. The use of Lavasul, a mixture of sulphur and coke which can be melted and cast, permits the construction of towers of any desired shape, at a relatively low cost. The material is strong and highly acid resisting. The Wilson internally cooled tower is made of this material, the usual packing being replaced by a number of horizontal glass tubes, through which cooling water is circulated. These towers have a high absorption capacity and make possible the consistent production of a 24 deg. Bé. acid.

The continuous production of alum from bauxite has been made possible by the application of continuous settling methods. The introduction of multiple-effect evaporation for the final boiling-down is retarded by the lack of a suitable material for evaporator construction.

The development of the lacquer industry has led to the production of the solvents, ethyl, butyl and amyl acetates by the heavy chemical manufacturer. The chemical engineer is consequently called upon to solve many problems in distillation. The replacement of calcium acetate by acetic acid, produced either synthetically or by extraction processes, will simplify many of these by allowing the use of continuous methods.

In conclusion it may be said that the value of the chemical engineer has been appreciated by the industry for some time. The recognition of the value of the industry by the chemical engineer has been more slow, but there are evidences of a change in this viewpoint. The recent publications of the Research Laboratory of Applied Chemistry of the Massachusetts Institute of Technology on the rate of conversion of  $\text{SO}_2$  and the absorption of gases indicate a growing appreciation of the fundamental nature of the heavy chemical industry and its dependence on the chemical engineer.

## Calcium Biphosphate Ruled Fine Chemical

AFTER a hearing which had continued since the beginning of January, a decision was finally handed down by A. A. Hudson on May 25 in the British case involving the classification of calcium biphosphate. The material, which is used as a substitute for cream of tartar in baking powder production, was originally included in the list of products subject to the 33½ per cent import duty, but was later removed after a referee's decision had pronounced cream of tartar a heavy chemical and hence immune to the tax.

The present appeal for re-inclusion of calcium biphosphate among taxable products was made by two large domestic manufacturers and was opposed by the British Chemical and Dyestuffs Traders' Association and numerous importers. After the presentation of voluminous evidence and further delay in the inquiry, Mr. Hudson, the present referee, concluded that calcium biphosphate of baking powder quality is a fine chemical and as such should be restored to the dutiable list.

While very welcome, of course, to the British producers of the salt, this decision has aroused great consternation, not to say positive resentment, among the opponents of the reclassification. This feeling appears remarkable when it is considered that in all previous cases of this type the decisions have been accepted without comment. A contributing element in the dissatisfaction of the merchants was the fact that no reasons were given for the decision, contrary to past custom. In any event, it revived the question of distinguishing between a fine and a heavy chemical.

In the evidence taken it was found that the imported product, low in calcium sulphate, came principally from America. The decision seemed to imply that while American methods of manufacture might characterize it as a heavy chemical, this fact did not affect the domestic classification.

## Post-War Developments in Heavy Chemicals

SUCH fundamental changes in many directions have come over the heavy chemical industry during and after the War that there is a fairly sharp dividing line between pre-war and post-war practice, although even before the War there were signs of the changes to be seen. The differences between pre-war and post-war conditions may be briefly summarized as follows:

A desire has grown up in manufacturing countries to be independent of imports wherever possible, and research and invention have been greatly stimulated. As a result of this, synthetic processes are becoming more and more important. Economy in production of power from coal has reduced the relative importance of water power; and finally the new processes have tended to encourage the growth of large manufacturing units, with adequate organizations for research as well as for financing the business and disposing of the products. This latter tendency is likely to facilitate the consummation of international arrangements to improve manufacture and distribution.

The principal recent achievements of the industry have been in connection with high pressure synthesis of nitrogen products and certain organic chemicals such as methanol and the hydrogenation products of coal; the production of various cellulose products such as artificial silk and nitrated cellulose lacquers; and certain new processes such as acetic acid from acetylene and sulphuric acid from calcium sulphate. All these new developments bring out in a striking manner the great importance of continued research, both pure and industrial.

Of the developments now taking place there is little doubt that the production of fertilizers, and the study of agriculture to which it has led, is from the world point of view by far the most important.

# READERS' VIEWS AND COMMENTS

*An Open Forum*

*The editors invite discussion of articles and editorials or other topics of interest*

## *The A-B-C of Corrosion Resisting Steels*

*To the Editor of Chem. & Met.:*

Sir—I have noted F. R. Palmer's article on "The A-B-C of Corrosion Resisting Steels" in the March issue with much interest. Whether limitations of space are accountable for some of the statements Mr. Palmer makes is not known, but in all events, I feel that attention should be called to some of these, which, if not erroneous, are at least misleading.

In the first place, Mr. Palmer makes no distinction between the stainless irons with low carbon content and the stainless steels with relatively high carbon, when he generalizes analyses in classes "A" and "B" by putting carbon less than 0.4 per cent. Within this range of carbon, widely differing physical properties will be obtained in stainless alloys the same as in any alloy steel. For instance, the statement is made under the heading of "Toughness," for Class "A" material, that it is "structurally dependable, not brittle in sharp notched specimens or under impact." Within the given carbon range, we find variations in the Izod value from a maximum of 30 ft.-lb. for material with 0.37 per cent carbon to a maximum of 120 ft.-lb. for 0.10 per cent carbon with the same chromium content. These values are widely different and might lead to possible disaster if material of the wrong carbon content were specified.

Similarly, the hot working qualities of material will also vary with carbon content, the higher carbon alloys being quite hard to work, particularly to pierce in the form of tubes and to roll into sheets. Consequently, the statement "readily forged, pierced or rolled" does not conform to facts. As regards material of Class "B," the same applies, since the carbon content affects the properties very markedly. There are virtually no commercial alloys of this chromium content with carbon in the neighborhood of 0.40 per cent. Practically all commercial alloys of this class are produced with carbon under 0.12 per cent or even lower.

Under the heading "Grain Growth," we find the statement that simple chromium irons or those containing high silicon or aluminum are subject to dangerous grain growth and become very brittle. Inasmuch as the limits defining dangerous silicon or aluminum content are not mentioned, this statement does not carry much weight. Many steels are subject to grain growth at high temperatures and will become brittle if heated excessively, and the condemnation of stainless alloys of this composition is quite as true for many other varieties of steel.

Under the heading "Riveting" the statement is made that this composition—namely, 16 per cent chromium—"Due to the low impact values, not desirable for either hot or cold rivets." This is incorrect. The original Du Pont nitric acid plant at Gibbstown, N. J., contains nearly ten tons of rivets made from an alloy with approximately 17 per cent chromium, 0.85 per cent silicon, 0.10 per cent carbon. Once the proper procedure for riveting

was ascertained, no difficulty whatever was experienced in driving rivets nor in keeping them in place after they were once driven. This plant has been in operation for over a year and is entirely satisfactory. These rivets were made with both hot and cold upset heads and driven both hot and cold. For this particular analysis, rivets should not be heated in excess of 1,500 deg. F., while for the 14 per cent stainless iron, 1,450 deg. F. is the upper limit of temperature. As regards resistance to scaling, the Class "B" alloys may be used successfully at temperatures running 100 to 150 deg. higher than those of Class "A" with equal carbon content.

The question of strength at elevated temperatures is most important for it determines the stability and safety of various structures and apparatus. To depend upon data obtained by short-time tests is hazardous, and information derived from long-time tests is as yet very incomplete. So far, indications are that Class "C"—namely, the nickel chromium combination—is the best material for use in high temperature installations. Class "B" material, with low carbon, appears to have a blue brittle range at 750 to 1,000 deg. F.; but under this range, and above it up to about 1,300 deg. F., this analysis appears reasonably safe. Class "A" also appears safe, but so far very few results of long-time tests have been published.

W. M. MITCHELL.

Development Division,  
Central Alloy Steel Corporation,  
Massillon, Ohio.

## *Mr. Palmer Replies*

*To the Editor of Chem. & Met.:*

Sir—Dr. Mitchell's comments are of considerable interest. The article to which he referred and the table which it contains were especially intended to sift from the enormous amount of available information a few fundamentals and assemble them into a logical form, easy to comprehend and digest. Dr. Mitchell's comments go into considerable detail and fully to discuss the various points which he mentions would mean to expand the whole subject back into its original voluminous form.

Dr. Mitchell's comments regarding the effect of carbon within each group of metals correspond exactly with the writer's statements made in connection with the table. The steels within any given group are not interchangeable and must be used with due consideration of their ultimate chemical analysis. The variation of physical properties with carbon content is not new and is common to most steels with which we are quite familiar, but the fact that a stainless iron can completely change in its characteristics when the chromium exceeds about 15 per cent is something of a novelty in metallurgy and it is this change which gives rise to Groups "A" and "B."

The comments seem to focus primarily on the distinction which the author has drawn between the inherent toughness of Groups "A" and "B" at room temperature and their structural dependability at elevated tempera-

tures. This viewpoint is attacked from several directions but appears to represent the principal divergence in views. This is difficult to understand because Dr. Mitchell certainly knows that the steels of Group "A" are very much tougher than the steels of Group "B" in notched sections, and the mere fact that carbon variations within Group "A" influence the Izod values in a perfectly logical manner, does not in any way explain why the steels of Group "B" in their normal hot rolled or annealed condition show Izod values of only 1 to 5 ft.-lb. When you can take a  $\frac{1}{4}$ -in. bolt made from a Group "B" steel and clip it off with a 2-lb. hand-hammer, you have, in the writer's opinion, a steel which is not tough in notched sections. The fact that bolts made from Group "B" steels have been successfully used does not in any way alter this conclusion.

Dr. Mitchell's views on the use of simple chromium-irons in Group "B" at elevated temperatures are even more astonishing. It is again beside the point to mention the fact that all steels are subject to grain growth at *some* temperature. We are not talking about the *ordinary*, but the *extraordinary*, and the tendency toward grain growth in some of the chromium-irons in Group "B" is almost without precedent in structural steels. When hot-rolled plates  $\frac{1}{4}$  in. thick can be produced with only one grain running from one side to the other; when thin tubular sections can actually become so porous that they will leak water due to grain growth; and when extra-heavy iron pipe sizes can become so brittle after several months of service at 700 deg. or 800 deg. F. that they can be smashed with a hand-hammer, it is time to post a warning against the use of steels of this type for high-temperature service.

The writer feels that there can be no compromise in the statement that chromium irons of Group "B" in their simplest form, or, with the addition of silicon or aluminum, are not dependable for high-temperature high-pressure service, and most construction engineers working on this type of apparatus are not interested in an analysis which "appears reasonably safe."

The same divergence of opinion is found under the head of riveting. On the riveting job to which Dr. Mitchell refers, tank fabricators worked for weeks and months to try to make a rivet head stay on. This was true of rivets in both Group "A" and Group "B." The mere fact that a method was ultimately found whereby Group "A" and Group "B" rivets could be used does not alter the fact that these steels are not *desirable* for hot rivets. In the first place these rivets must be specially headed with a fillet under the head and with a specially shaped head which will permit of some hot working from the bucking-up tool. The plates must be carefully lined up and reamed so that they will not notch the rivet in the middle. The rivet hole should be countersunk on both sides so that no sharp notches will appear on the rivet when it is driven. The rivet must be heated in a pyrometer-controlled muffle furnace and must not be heated above 1,500 deg. F. In the face of this imposing list of restrictions, the writer scarcely expected contradiction when he said that these steels were not *desirable* for hot rivets.

Attention should be called to a misprint in the table under Group "B" opposite "scale resistance." This should read "Superior to Group 'A'—recommended for temperatures above 1,500 deg. F." F. R. PALMER.

Metallurgist,  
Carpenter Steel Company,  
Reading, Pa.

## Recent Legal Decisions

Digest of cases decided in high courts, illustrating principles of law applied to industry.

### McAfee Aluminum Chloride Patent Upheld in Oil Cracking Suit

A DECISION on May 23 of the United States Circuit Court for the fifth circuit in favor of the Gulf Refining Company in the suit brought against it by The Texas Company may mark the end of 15 years of litigation over the aluminum chloride process of cracking petroleum. This decision, which had been appealed from the district court at Houston and may yet be carried to the United States Supreme Court by The Texas Company, affirmed the lower court's view that the Gulf company is entitled to ownership and full benefit of Patent No. 1,424,574, granted Aug. 1, 1922, to the Gulf Refining Company, as assignee of Almer M. McAfee.

The case is of particular interest because it first involved the contention that Dr. G. W. Gray, then chief chemist of The Texas Company was the actual inventor rather than McAfee, who in 1913 had worked at Dr. Gray's direction at Bayonne, N. J., and Port Arthur, Texas. Failing in establishing this contention as the result of a decision in the U. S. Court of Appeals of the District of Columbia on March 22, 1922, The Texas Company then made the claim that even if McAfee was the inventor of the process, the invention was its property because of McAfee's relation to it as an employee at the time the invention was made. The court, however, pointed out that "A party in litigation who has asserted a particular claim, title or right cannot afterward assume a position inconsistent with that claim to the prejudice of an adversary who has acted in reliance on such claim being as previously made."

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### Lower Court Affirmed in Rubber Accelerator Suit

IN A RECENT decision handed down by the U. S. Circuit Court of Appeals for the Second Circuit, in the case of the Grasselli Chemical Company vs. National Aniline & Chemical Company, Inc., relating to the vulcanization of rubber, the decree of the District Court for the Southern District of New York, was affirmed.

In the original action the Grasselli Chemical Company sued National Aniline & Chemical Company, Inc., for alleged infringement of United States patent 1,149,580, issued to F. Hofmann and K. Gottlob. The first and fourth claims—the only ones in suit—comprise the process of producing vulcanized rubber by incorporating with rubber a small amount of an ammonium compound having a dissociation constant greater than  $1 \times 10^{-8}$  and having a basic reaction at the vulcanization temperature. During the trial the defendant's experts showed that most commercial accelerators have been of less than the necessary constant, or an indeterminate constant.

Furthermore, it was shown that David Spence and C. R. Boggs had reduced to practice the use of certain accelerators prior to the so-called invention of Hofmann and Gottlob. As a result, the bill in equity was dismissed by the District Court, and appeal followed.

# CHEMICAL ENGINEER'S BOOKSHELF

## Properties of Silica

**THE PROPERTIES OF SILICA.** By Robert B. Sosman. The Chemical Catalog Company, Inc., New York. 856 pages. Price, \$12.50.

*Reviewed by WILLIAM STERICKER*

"ONE OF the most striking things about silica is the variety of aspects under which it occurs." There are eight "better known" modifications which include the various forms of quartz, tridymite, and cristobalite together with vitreous silica. In addition, there are two groups about which little is known. This book is limited to a study of these phases, their transformations and their physical properties. The chemist may be disappointed to find that "from the point of view adopted for this presentation there is no such thing as a chemical property of an individual substance" but only of systems of two or more components. On the other hand, he will find that this viewpoint is refreshing and yields "a good supply of fruitful hypotheses."

The research worker in chemistry, ceramics, or petrology will find this a valuable reference book since Dr. Sosman has gathered the scattered literature and unified it. This alone would be an achievement but the volume is also worthy of careful study as a textbook by all those who are interested in silica. For example, the ceramic engineer may learn the answer to his knotty cement problem which lies in the transformations of silica. Although the book is not easy reading, the reviewer found himself carried on and on by the clear, logical, coherent development of the subject. We hope that Dr. Sosman will extend his work to systems containing silica with a second component.

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## Hydrochloric Acid Production

**HYDROCHLORIC ACID AND SODIUM SULFATE.** By N. A. Laury. Chemical Catalog Company, Inc., New York. 1927. 122 pages. Price, \$4.

*Reviewed by ANDREW M. FAIRLIE*

THIS little book comprises a brief chapter on the theory and heat calculations involved in the action of sulphuric acid on sodium chloride, two chapters on the properties of hydrochloric acid and sodium sulphate, and one chapter each on raw materials and finished products, on furnaces, on the Hargreaves process and other processes, on electrolytic and other methods using chlorine and hydrogen, on absorption principles and equipment, and on economic factors, costs, handling and shipping. These chapters treat of the subject in hand concisely and clearly. The chapter on furnaces especially is well handled and amply illustrated. The inventor of a rotary oil-burning salt-cake furnace, the author has not yielded to any temptation to stress unduly his own invention. Any criticism here must be that the Laury rotary furnace is treated in insufficient detail. For example, the reader is left to wonder what does the grinding in the grinding chamber. Not every reader has a copy of Laury's patent (U. S. 1,435,930), which shows that the grinding chamber is a ball mill.

In some places the English might be improved (for example, on page 60: "oil or gas are used"). On page 63 instructions for making a good niter cake pot, with specifications as to the analysis of the iron of such a pot, would be appropriate, but are lacking. On page 110 the author's ideas as to what constitutes a good type of acid distributor for an absorption tower would have been of interest. The reviewer regrets the adoption of the Lunge practice of consuming valuable space with patent digests, most of which are of little value. These, if published at all, should be grouped together in an appendix. The footnotes referring by name to American manufacturers of various kinds of plant equipment are of practical use, but the name of the manufacture of the Laury furnace is omitted, as is the patent number. Some very useful tables are given, for example, a table on the resistance of various alloys, including the new chrome-steel alloys, to the action of hydrochloric acid.

The book is well bound and well printed, and, barring the patent digests, presents the most useful available information on the subject in convenient form.

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## Mathematics for Chemists

**MATHEMATICAL PREPARATION FOR PHYSICAL CHEMISTRY.** By Farrington Daniels. McGraw-Hill Book Company, New York. 1928. X + 308 pages. Price, \$3.00.

*Reviewed by TOMLINSON FORT*

WRITTEN by a professional chemist, this surprisingly interesting book proves extremely gratifying to the mathematician upon finding an American chemist who knows so much mathematics.

As a source of problems the teacher or the writer of undergraduate mathematics text-books will find the book of value. Problems from chemistry afford an interesting variation from those more usually given. The reviewer was particularly impressed with the common sense approach to many topics and with the discussion of various simple things frequently omitted from ordinary courses. The book is decidedly an addition to text-book literature. The author says that it was based on a one semester course for sophomores, but he is not proposing to substitute it for the usual courses. In fact it is hard to believe that the necessary time should be taken in the sophomore year for such a course. It seems that it could be given later as a review to students of chemistry who had had the usual courses but who wished to freshen their memories on their mathematics and to study its applications within their special field. Such a book should also be of service to the mature chemist who wishes to study mathematics without a teacher in order to read modern literature on physical chemistry.

And now to the task of calling attention to things about which a mathematician cannot be enthusiastic. These consist primarily, although not wholly, in the use of some terms that are in bad repute with mathematicians and in an undue laxness in the treatment of limits. At times the reviewer is in doubt if the author himself really always thinks of his calculus as a study of certain limits

or if in his thinking he is retaining remnants of the abandoned "little zero" point of view. As we all know, there is a very real difficulty in being rigorous and at the same time understandable to a sophomore. In fact it is likely that no one of us objects to some frank and admitted lapses from rigor in undergraduate teaching. In the opinion of the reviewer, however, the author goes too far in this direction, particularly when discussing the foundations of calculus; and in the matter of definition, there seems to be a lack of precision in the use of some mathematical terms.

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### Sources of Chemical Information

A GUIDE TO THE LITERATURE OF CHEMISTRY. By E. J. Crane and Austin M. Patterson. John Wiley & Sons, Inc., New York. 424 pages. Price, \$5.

THAT the extent of the printed matter relating to chemistry has long been recognized as a troublesome and unescapable problem, is indicated by the expanding volume, in turn, of the "literature on literature." The present contribution to this secondary, though growingly indispensable, group represents an endeavor to aid the man to whom chemical writings are directed, in a profitable and comprehensive orientation within their wide scope.

It would seem, on first inspection, to be a book written principally for men just completing their preliminary chemical training. There are discussions on the nature, functions and serviceability of books, periodicals, patents, indexes, libraries and other sources, with all of which a trained man can be assumed to have some familiarity. But although confronted from the outset with a task of definite limits, the authors, with their background of editorship on *Chemical Abstracts*, have covered the field in such a clear, instructive manner that the book assumes a much wider range of interest. This applies, of course, to different sections varying with the special interests of the reader; but in each case he can be satisfied that he has received the information that will enable him to set out to his proper sources effectively equipped.

In addition to the main text there are several extensive appendixes containing lists of periodicals, libraries and publishers, and, above all, a select choice of books compiled painstakingly by consultation with a number of authorities. All in all, the authors have succeeded in producing a book well suited for directing a confused seeker of chemical information through the difficult ways and uneven expanse of technical printed matter.

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### Behavior of Prices

THE BEHAVIOR OF PRICES. By Frederick C. Mills. National Bureau of Economic Research, Inc., New York. 598 pages. Price, \$7.00.

THERE is no question but that prices and price relations play a fundamental part in the production, distribution and consumption of goods. The changes in prices of commodities stimulate or retard production and consumption. But in addition there are numerous relations which tie all prices into a highly complex system, "a system like a living organism in its ability to recover from the serious disorders into which it periodically falls." "The Behavior of Prices" has as its objective first, to secure a fuller understanding of individual commodity prices and, secondly, to increase our knowledge of the price system and of the inter-relationships between its component elements.

Two significant facts are brought out by the study. First, is the existence of wide diversities in the behavior of prices of individual commodities, and secondly, is the existence among the diversity of price movements of just those uniformities for which the scientist searches in attempting to reduce masses of facts to understandable terms. The present study and those which have preceded it in this field have gone only a little way in the search of principles of order among the variations in the price system, but there have been revealed numerous inter-relations and uniformities, and there have been found many clues to other regularities. It is in the existence of these regularities that lies the hope of a fuller understanding of the working of the system of prices.

\* \* \* \*

FOUNDRY WORK. Second Edition. By R. E. Wendt. McGraw-Hill Book Company, New York. 236 pages. Price, \$2.

Professor Wendt is head instructor in foundry practice at Purdue; he is also a practical foundryman. It is not surprising, therefore, that his book, while primarily a text, is equally valuable as a practical handbook on foundry practice. The present edition, coming five years after the first, includes many new principles and illustrations. It covers molding, dry-sand core-making, the melting and mixing of metals, and problems.

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### Recent Foreign Publications

EVOLUTION DE LA FABRICATION DE L'ACIDE SULFURIQUE. (Development of the lead chamber process for sulphuric acid manufacturing in recent years). A collection of articles published in *L'Industrie Chimique*. L'Industrie Chimique, Paris. 457 pages. Price, 60 Fr.

This book begins on the subject of the chamber process where the last edition of Lunge ended in 1916, and assembles material published up to the end of 1926. Although most of the material has been published previously in *L'Industrie Chimique*, the book is much more than a collection of reprints, the various treatises having been edited and arranged in logical sequence. Moreover, the scope of the work reported is international and all the important developments of the last decade are treated. A certain amount of propaganda for equipment and methods which are not taken very seriously in this country has crept into the compilation, but on the whole, the volume deserves a place on the shelf beside Lunge.

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ATOMSTRUKTUR UND ATOMBINDUNG. By J. Stark. Polytechnische Buchhandlung A. Seydel, Berlin. 198 pages. Price, 9M.

A discussion of atomic structure and linkage in light of the results of physical and chemical research up to the present day. The book is of a decidedly theoretic tone, drawing heavily upon mathematics and optics, in addition to physical chemistry, for its explanations of atomic phenomena. The publisher has succeeded in offering the book at a low price without unduly impairing its appearance.

\* \* \* \*

GLI ACIDI INORGANICI. By Antonio Aita and Henry Molinari. Ulrico Hoepli, Milan. 472 pages. Price, 48 lire.

An extremely interesting book on the commercial production of sulphuric, nitric and hydrochloric acids. Emphasis throughout is placed on European practice, although American equipment is described. The descriptions of nitrogen fixation by the arc process and ammonia oxidation are particularly informative.

## Selections from Recent Literature

**BETTER BAKING.** L. Elion. *Zeitschrift für angewandte Chemie*, March 3, pp. 230-1. A new development which has great potential possibilities in baking is found in the application of certain yeast nutrients. With such a substance, for example, as super-rapidase the fermentation process necessary in raising dough can be enormously accelerated. This product, though not yet marketable, shows great promise of usefulness.

**SUPER-CENTRIFUGE.** H. Winkelmann. *Chemische Fabrik*, Apr. 25, pp. 227-8. Illustrated description of the long basket construction type of centrifuge (super-centrifuge). This machine is remarkably effective in separating materials with relatively small differences in gravity. It operates at 15,000 to 45,000 r.p.m., with little or no perceptible vibration.

**TANNING PROBLEMS.** Jas. A. Craven. *Leather World*, Apr. 12, pp. 278-9. A lecture on occurrence, prevention and cure of some troubles commonly encountered in tanning. These include iron stains, blooming out (efflorescence) of  $\text{Na}_2\text{SO}_4$ , damage to leather by fungi, and similar difficulties.

**PAINT FILMS.** E. Stern. *Korrosion und Metallschutz* 1928, pp. 153-9. A micrographic study was made of the behavior of paint films on exposure to water, steam, acid and ammonia water. The vehicles included linseed, tung and other drying oils. In general, the more homogeneous the oil composing the vehicle, the more resistant the paint to exposure.

**SYNTHETIC RESINS.** J. H. Frydlander. *Revue des Produits Chimiques*, Apr. 15, pp. 241-6; Apr. 30, pp. 281-6. A comprehensive review of the preparation, properties and uses of cumarone resins and the glyptal (glycerol-phthalic acid) type of resins. Major applications which are described include compositions of these resins for varnish bases and for moldable plastics.

**OXIDATION.** E. B. Maxted. *Journal of the Society of Chemical Industry*, Apr. 20, pp. 101-6T. Certain compounds of V, notably Na vanadate, are active catalysts of oxidation by air at low temperatures (about 300 deg. C.). The process is applicable to many benzene and naphthalene derivatives and widens the availability of the cheapest source of oxygen, namely air.

**GASIFICATION.** Gulich. *Het Gas*, May 1, pp. 201-4. A report of the experimental work by which the Jena gas plant increased its oven yield of gas from 39 to 50 or more cu.m. This improvement was effected without any sacrifice in calorific value of the gas; in fact there was a slight increase in heat content.

**CORROSION RESISTANCE.** R. T. Rolfe. *Iron and Steel Industry*, April, pp. 205-8. A review of the use of Cu in steel to improve its resistance to corrosion, and of the effect of small additions of Cu on the acid resistance of cast iron. Considerable improvement can be obtained; but the goal of rust proof cast iron is not yet reached.

**WELDING COPPER.** Kalisch. *Zeitschrift für angewandte Chemie*, Apr. 14, p. 361. Copper (or brass or bronze) can be successfully welded by a pressure welding method. The procedure is described.

**ELECTROLYTIC IRON.** G. Neuendorff and F. Sauerwald. *Zeitschrift für Elektrochemie*, April, pp. 199-204. In the separation of iron from its fused oxides or salts by electrolysis, recent improvements have improved the current yield and made possible preparation of Fe practically free from C. Chrome iron ore yields an alloy of Fe, Cr and C; but alloys with Mn are not easily made by this method.

**PREVENTING CORROSION.** *Zeitschrift für angewandte Chemie*, Apr. 28, pp. 435-8. A symposium of the Reichs ausschuss für Metallschutz. Papers were read by Gebauer, Rust-Proofing with Cadmium by the Udylite Process; Rackwitz, New Methods of Surface Protection of the Light Metals, and Kerschke, Measuring Hardness of Coatings.

**HYDROGENATING CO.** G. T. Morgan, R. Taylor and T. J. Hedley. *Journal of the Society of Chemical Industry*, May 4, pp. 117-22. The technique of high pressure catalytic reduction of CO is discussed, and the necessary equipment is described. Of the various active catalysts, those containing cobalt tend toward formation of higher alcohols than methyl. Products obtained, and methods of separating them are considered. Illustrated with photographs and diagrams.

**FOAM EXTINGUISHERS.** J. Hausen. *Chemiker-Zeitung*, May 2, pp. 348-9. In the chemical industry, where the use of water or chemical extinguishers is often dangerous or impractical, installation of foam fire extinguishing equipment may be the most effective fire protection. A typical installation for protection of a factory using or producing flammable liquids is described and illustrated.

**FRACTIONATION.** H. Brandes. *Chemische Fabrik*, May 9, pp. 261-2. A simple graphic method is described for ascertaining the efficiency of a fractionating column from the composition of the distillate. Sample graphs are shown and explained.

**NITRIFIED STEEL.** Leon. Guillet. *Comptes rendus*, Apr. 30, pp. 1177-80. A special treatment for surface hardening of steels by nitrification is described. A chrome steel, nitrified in this way, has been found particularly useful in automobile engine cylinders (where it prolongs cylinder life and reduces oil consumption) and in certain aircraft parts (where its smooth surface permits direct rubbing contact with light metal alloys).

**NON-SLIP BELTS.** Kirsch. *Chemische Fabrik*, May 9, pp. 262-3. Illustrated description of a new design of transmission belt, grooved with suction channels to prevent slipping. Being made of rubber, the belt is superior to leather (even proofed leather) in resistance to the corrosive and destructive influences which belting encounters in chemical factories.

**NOBLE METALS.** F. Chemnitius. *Chemiker-Zeitung*, May 16. Metallic silver can be refined to high purity (99.95 to 99.98 per cent) by electrolysis of the nitrate, made from alloys containing at least 80 per cent Ag. Current efficiency of 96-97 per cent can be attained. Similarly, gold can be refined to 99.9 per cent purity from solutions of the chloride. Operating conditions and apparatus are described and illustrated.

**LOW TEMPERATURE TAR.** G. T. Morgan. *Journal of the Society of Chemical Industry*, May 18, pp. 131-3T. Progress in production and treatment of low temperature tars includes a new method of separating true phenols from their phenate soluble impurities; increase in yields of some useful constituents, by solvent extraction methods; and recovery from the phenols of amorphous resinols.

**CARBONIZATION.** J. T. Donneoly, C. H. Foott, H. Nielsen and Jos. Reilly. *Journal of the Society of Chemical Industry*, May 18, pp. 139-42T. Coal can be pre-oxidized before carbonization by heating at about 185 deg. C. in a current of oxygen. Several separate reactions occur; among the oxidation products are  $\text{CO}_2$  and  $\text{CO}$ . Results of carbonization of the pre-oxidized coal will be reported later.

**WATER GAS.** B. Neumann and G. Koehler. *Zeitschrift für Elektrochemie*, May, pp. 218-37. The mass action constants of the water gas reaction were determined from both directions in the temperature range 300-1,000 deg. C. A cobalt catalyst which was effective above 500 deg. C. had to be replaced by iron below 500 deg. C. Above 400 deg. C. equilibrium is so readily established that the constants agree when determined from either direction. The technical importance of the mass action constants is explained.

**CALORIMETER.** Walther Kangro. *Zeitschrift für Elektrochemie*, May, pp. 253-6. A new adiabatic calorimeter.

for high temperature measurements of thermal effects (at 800 or 900 deg. C.) comprises an electric furnace containing a silver block, with resistance thermometer, surrounded by another electric furnace with resistance thermometer. It can also be used at ordinary temperatures. Illustrated.

**CHROMIUM PLATING.** A. Siemens. *Zeitschrift für Elektrochemie*, May, pp. 264-9. A review of the present status of the art of Cr plating. A bibliography of 41 references is appended.

**PORTLAND CEMENT.** *Zeitschrift für angewandte Chemie*, May 12, pp. 476-9. Symposium of the Verein Deutscher Portland-Zement-Fabrikanten. Papers were read by E. Jaenecke, Recent Studies of Alite; Hans Kuhl, Chemistry of High Grade Cements; R. Nacken, Report of Recent Cement Researches; E. Probst, Mortar and Concrete; J. Meyer, Porous Building Materials from Cement, and E. Schott, Cracking of Glass Plates by Test Cakes.

**CHLORINATED NAPHTHALENE.** P. Ferrero and R. Wunenberger. *Helvetica Chimica Acta*, May, pp. 416-25. In a study of possible commercial outlets for surplus Cl gas, vapor phase chlorination of naphthalene was investigated. A method is described which gives alpha-chloronaphthalene as main product, with small amounts of higher chlorination products. Iodine is an effective Cl carrier.

**CARBONIZATION.** F. Schwers. *Chimie et Industrie*, April, pp. 583-8. A review of low temperature carbonization, with emphasis on recent improvements. These include applications of the Pintsch apparatus and of the Salerni oven. The latter is useful with various types of fuel, lignite, oil shale, etc.

**DIASTASE INVERSION.** Emile Saillard. *Chimie et Industrie*, April, pp. 599-601. In the refining of beet sugar, the optimum pH for filtration is between the equivalent concentrations of SO<sub>2</sub> and acetic acid. In juice acidified with acetic acid, the optimum pH is 4.05. At this acidity and at ordinary temperature the formation of reducing sugars is negligible.

**ROD MILL.** *Zellstoff und Papier*, May, pp. 293-4. Illustrated description of the use of rod mills in grinding paper materials. The Marcy type of mill is preferred. The output is much larger than for hollanders and Jordan mills.

**SOLVENT RECOVERY.** *Industrial Chemist*, May, pp. 191-98. Activated carbon, though long used as bleaching agent, has only recently been applied industrially for absorption of gases. Its advantages are more efficient extraction, reduced plant size, and less heat requirement. On the Continent successful technology has been developed for use in connection with the production of natural gas, rubber coating, and petroleum fractions.

## Papers Presented Before the Society of Chemical Industry, London

**HYDROGEN FOR OILS.** A. Edgar Knowles. The gas used in hydrogenating oils must be produced electrolytically, to avoid contamination by other gases as in the Haber or Lane procedures. The cost of the process varies with the price of electricity and the market for oxygen. Under the conditions of operation the consumption of electricity is very favorable.

**BEET SUGAR.** J. Kwantes. The seasonal manufacture of sugar from beets falls into several processes: washing; extraction of juice by diffusion, after careful slicing; epuration with lime (quicklime, milk or sucrate), treatment with CO<sub>2</sub> and sulphitation; evaporation to 60 per cent of sugar; crystallization and centrifuging. Water is an important factor, in both solution and conveying.

**ROTAMETERS IN INDUSTRY.** H. R. Trost. These instruments measure liquid flow by reversing the principle of Venturi meters. The float does not touch the walls of the tube, and once the instrument has been calibrated, the only factors are the visibility of the float and the maintenance of a vertical position.

**SUGAR FROM WOOD.** W. R. Ormandy. Sugar from wood cellulose has become more feasible since the recognition of the correct concentration of HCl in the treatment. A plant for the Rheinau process uses a sawdust dryer and eighteen diffusion batteries, in which the sugar content increases to 27 per cent and the HCl drops to 26 per cent. By careful evaporation, using hot inert oil, most of the HCl is removed and further treatment reduces it to 2 per cent in the resultant powder. The product is treated according to its prospective application.

## Government Publications

Prices indicated are charged by the Superintendent of Documents, Washington, D. C., for pamphlets. Send cash or money order; stamps and personal checks not accepted. When no price is indicated pamphlet is free and should be ordered from Bureau responsible for issue.

The International Cartel Movement, by Louis Domeratzky. Department of Commerce Trade Information Bulletin 556.

The Health of Workers in Dusty Trades—I. Health of Workers in Portland Cement Plants. Treasury Department Public Health Bulletin 176. 45 cents.

Petroleum Refineries in the United States, January 1, 1928, by G. R. Hopkins. Bureau of Mines Information Circular 6065.

A Simple Method for Determining

the Oil Content of Seeds and Other Oil Bearing Materials, by D. A. Coleman and H. C. Fellows. Department of Agriculture Technical Bulletin 71. 5 cents.

Potash Struck by Four Government Tests in Texas. Mimeographed statement from U. S. Geological Survey giving results of analyses of cores from four Government potash tests wells in Texas.

The Production of High-Alumina Slags in the Blast Furnace for the Manufacture of Alumina Cement, by T. L. Joseph. Bureau of Mines Serial 2869.

Notes on Extraction and Recovery of Radium, Vanadium, and Uranium Carnotite, by H. A. Doerner. Bureau of Mines Serial 2873.

Milling Baboquivari Ores, by E. S. Leaver and J. A. Woolf. Bureau of Mines Serial 2874.

Flue Dusts From Copper Smelters of the Southwest: Composition and Methods of Treatment, by William A. Sloan. Bureau of Mines Serial 2871.

Rock-Strata Gases in the Cripple Creek District and Their Effect on Mining, by E. H. Denny, K. L. Marshall, and A. C. Fieldner. Bureau of Mines Serial 2865.

Petroleum in 1926, by G. R. Hopkins and A. B. Coons. Bureau of Mines Mineral Resources separate. 15 cents.

Mineral production statistics for 1927. Preliminary mimeographed statements from Bureau of Mines on: Bauxite, Refined Primary Lead, Graphite, Iron, Slab Zinc and Rolled Zinc, Potash, Natural Sodium Compounds and Morates, Natural Masonry and Puzzolan Cements, Aluminum Salts, Fuller's Earth, Carbon Black, Mercury, and Mica.

Paper and Paper Products in Canada, by Norman S. Meese. Bureau of Foreign and Domestic Commerce Trade Information Bulletin 549. 10 cents.

Carnauba Wax—Brazil, by Consul General A. Gaulin, Rio de Janeiro. Bureau of Foreign and Domestic Commerce Chemical Division Special Circular 197.

Studies on Oxidation-Reduction, I-X. Treasury Department Hygienic Laboratory Bulletin 151. This volume contains the first ten of a series of articles published in Public Health Reports.

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The recently published Year Book of the American Engineering Standards Committee not only covers the many standardization projects both under way and approved, but also includes much information concerning the organization, membership, affiliations, aims and activities of the Committee. Copies of the Year Book may be had upon application to the Committee at 29 West 39th St., New York.

# THE PLANT NOTEBOOK

*an exchange for OPERATING MEN*

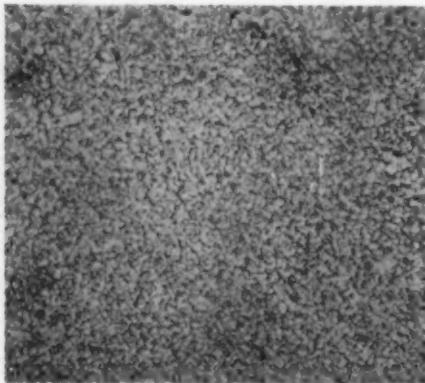


Fig. 1—Photo-micrograph Showing Crystalline Structure of the Weld  
(Magnification 100 X)

## New Principle Applied to Carbon Arc Welding

It is generally known that the carbon electric arc used for welding is normally a difficult phenomenon to control. The arc creates its own magnetic field, and in the passage of the welding current through the parts being joined, creates other magnetic fields of variable direction. The arc, therefore, tends to wander about seeking the path of least resistance between its own magnetic field produced by the passage of the welding current and the piece being welded. In some cases, this magnetic effect is actually enough to blow out the arc. Under ordinary circumstances, it is practically impossible to operate two arcs in close juxtaposition, as the magnetic disturbances are so great in this case that one arc continually blows the other out.

It is, therefore, of considerable interest that a new principle of operation, termed the "electronic tornado," developed by the Lincoln Electric Company, has been applied to carbon arc welding. The system has now been made commercially practicable, and is capable of producing ductile carbon-arc welds automatically and at a moderate cost.

Control of the arc is now made possible through the superposition of a strong magnetic field on the arc flame. In addition, the arc is given a gyratory motion of high velocity by rotating the carbon mechanically, which also tends to hold the arc in a straight line. The electronic tornado head consists, therefore, of mechanism which will rotate the carbon rod, feed it automatically as it is consumed, feed a fluxing material, and create a strong magnetic field about the arc. The field is weak at the

center of the arc, but becomes stronger as the arc departs from the geometric axis of the carbon rod. This results in a tendency for the arc to maintain itself in a centralized position of equilibrium.

Another feature of the new application lies in the means taken to prevent oxidation of the weld. It is generally conceded that many weld failures are due to the inclusion of oxides in the deposited metal. With the electronic tornado head, a flux which forms carbon monoxide is mechanically fed into the crater in the form of a ribbon or rope. At the high temperature of the arc, the monoxide immediately burns to dioxide, so that the operator is in no danger. The active part of the weld, however, is completely inclosed in an atmosphere of monoxide, so that, it is reported, oxidization is completely prevented.

The resulting weld produces a crystalline structure which is said to be identical to that of steel plate. The grains are shown in the accompanying photo-micrograph (Fig. 1) to be small and well defined. It will be noted that there is no evidence of oxide inclusion. In addition, it is to be noted that the welds are extremely ductile. This is definitely demonstrated in the case of the test pieces shown in Fig. 2.

In its application, the electronic tornado may be used in the form of a double welder, for example, as is shown in Fig. 3. The machine illustrated was built to weld oil derrick clamps. Two welds are made simultaneously at the rate of over 40 ft. per hr. for each head. This use requires no filler rod, as the several pieces are fused together directly.



Fig. 2—Test Pieces Made with the "Electronic Tornado"

## Vacuum System Leaks

When a small leak develops in a piece of process equipment which operates under vacuum, its detection may be difficult, although its presence may be suspected. In a recent issue of *Power*, M. S. Fitzwilliam suggests the use of oil of peppermint for such leak detecting. While the most certain method is always the water test under pressure, this frequently entails much labor and a lengthy shut-down. If a cloth saturated with oil of peppermint or some other extremely volatile and odoriferous material be applied at the various joints in the system where there may possibly be leaks, an assistant stationed near the atmospheric discharge of the air removal apparatus will be able to detect the presence of any in-leaking peppermint. A short time interval should be allowed between applications at various joints to allow the fumes to pass through the system if there is any leakage.

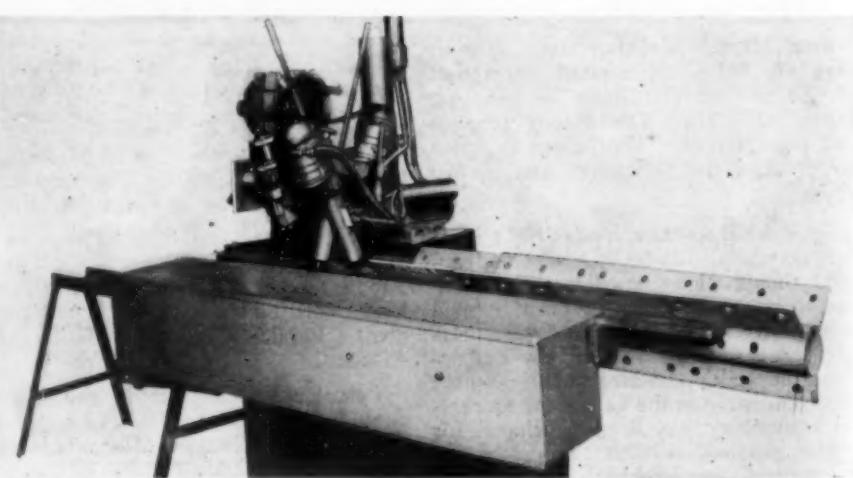
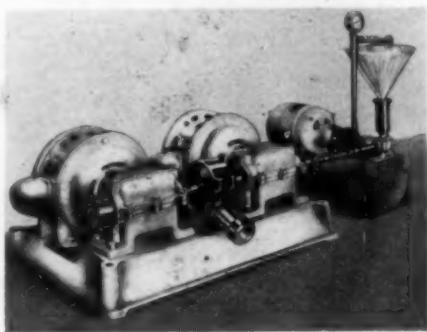


Fig. 3—"Electronic Tornado" Welder for Derrick Clamps

# EQUIPMENT NEWS

*from MAKER and USER*



"Junior" U. S. Colloid Mill

## Small Colloid Mill

The March, 1928 issue of *Chem. & Met.* described a large model of the U. S. Colloid Mill constructed by the U. S. Colloid Mill Corporation, 13th Street & East Avenue, Long Island City, N. Y. Announcement is now made of a small companion mill known as the "Junior." The mill is adapted for laboratory use or to the needs of the smaller manufacturer. Its capacity is said to be from 50 to 60 gal. per hour.

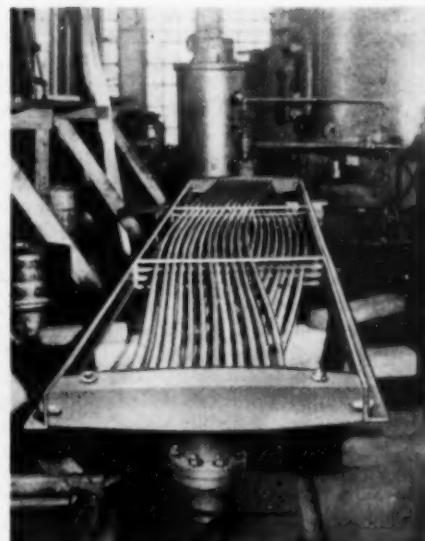
The accompanying illustration shows the new mill. In general, its principle is similar to the larger one. The constructional changes are those that are necessary to adapt the principle to the small sized unit. Two 3 hp. 3,500 r.p.m. motors drive the rotors through gearing at a speed of 7,000 r.p.m. in opposite directions. Material is fed through the hollow shaft of one rotor from a gear pump supplied either by a tank or funnel. A bypass around the pump is used to control the rate of feed to the mill. Material passes between the two oppositely driven rotors of the mill at their periphery and discharges from the casing. At the left of the mill is shown the adjustment calibrated in thousandths of an inch whereby the clearance between the rotors may be accurately regulated.

## New Cooling Apparatus

The Griscom-Russell Company, 25 Madison Avenue, New York City, are now marketing a new cooling device known as the G-R Bentube Section. This is shown in the accompanying illustration to be a series of Admiralty metal tubes set with an initial curvature into cast-iron headers at each end. The liquid or gas to be cooled, or the vapor to be condensed, passes through the tubes and the cooling effect is obtained either by showering water down over the tubes from distributing spray nozzles or by submerging the entire unit in a tank of water. As the cooling water is heated or evaporated in contact with the hot tubes, it leaves behind deposits of scale which would ordinarily accumulate until broken off by hand or machine. In the new cooler, however, hand scaling is not necessary because the changing of curvature of the tubes with change in temperature is said to effectively crack off all scale.

When the hot fluid passes through the tubes, the resulting expansion greatly accentuates the initial bowing of the tubes. If the flow of hot fluid is interrupted, the tubes again contract to their original curvature and thus crack off the scale. The same principle is applied in the G-R Bentube evaporator.

In service this change of curvature may be accomplished either by shutting off the flow of cooling water or by discontinuing the passage of hot fluid. In either case a changing curvature takes place which is sufficient to dislodge the scale. The new cooler is particularly recommended where cooling water is of a poor quality and is suggested for use in cooling oil, gas, jacket water and industrial liquors of various kinds. The units are of standard size and are interchangeable and these may be connected in series to give desired length of travel or in parallel to give desired capacity. Quick installation, ease of



The Bentube Cooler with Steam on the Tubes Showing Exaggerated Curvature

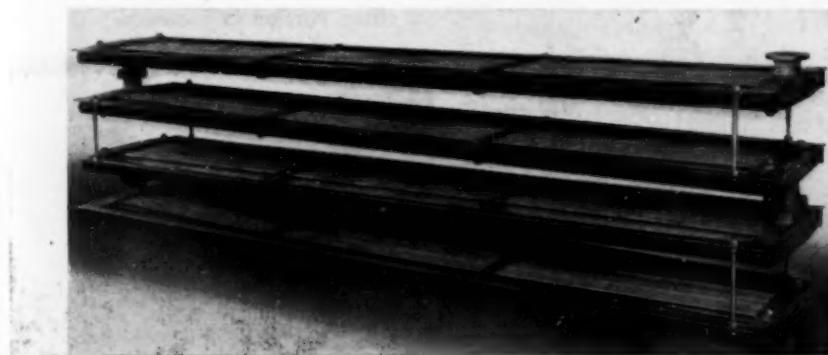
cleaning and long life are said to be additional features provided by the construction of these units.

## Die Stock

A new die stock especially intended for threading brass pipe has recently been placed upon the market by the Oster Mfg. Company, Cleveland, Ohio. The die is of the automatic quick opening type, eliminating the necessity for backing the tool off over the finished threads. Adjustment may easily be made for deep or shallow cuts. The dies themselves are made with a special cutting angle which is said to give a result superior to ordinary dies for brass pipe work.

## Air-Jacketed Motor

To meet the demand for motors for service in dusty or moist atmosphere, or when fumes are present in considerable quantities, the Wagner Electric Corp., St. Louis, Mo., has produced an inclosed motor surrounded by an air jacket open at both ends. A fan mounted on a shaft extension between the motor and the outer jacket provides a blast of cooling air over the inner casing and the stator laminæ. The construction is practically air-tight, and is provided with double-row self-aligning ball bearings at one end and deep groove ball bearings at the other. End thrust is thus provided for. The bearings are lubricated with grease and sealed in dustproof housings.



Bank of Bentube Coolers

The motors may be provided in single-phase repulsion-induction construction in sizes from 1 to 20 hp., and in polyphase squirrel cage construction in sizes from 2 to 30 hp. They are designed for a temperature rise not greater than 50 deg. C.

### Disintegrating Mixer

What is said to be a distinctly new departure in mixing equipment is a new product of the Robinson Mfg. Co., Muncy, Pa. The construction of the mixer is indicated in the accompanying drawing. Material which is fed into the center of the closed cover is mixed, agitated and comminuted for a predetermined length of time, after which it is discharged through the slide valve in the middle of the bottom. A brief explanation of the details of construction of the machine will make clear how this is accomplished.

The mixer proper consists of a sheet metal tank with a semi-cylindrical bottom, straight sides and a flat top. Mounted upon a through shaft which is driven by gearing at either end from a counter-shaft are a number of spiders or hubs with radiating arms which carry the mixing and conveying elements. These elements are of three types. The first type consists of scroll pieces supported at the ends of the radiating arms, and so arranged as to move material from the ends to the center of the tank. The second type of element consists of blades mounted on the arms inside of the scroll and so turned as to move the material from the center to the ends of the tank. It will be noted that these two elements are oppositely arranged either side of the center.

The third type of element consists of a number of shoes attached to the spider arms at their ends, opposite the scroll pieces. The shoes are adjusted in their relation to the outer shell of the mixer by means of set screws. The entering edge of each shoe is supported a short distance from the semi-cylindrical casing, while the trailing edge or heel is adjusted to bear against the casing, thus crushing any lumps of material with which it comes in contact. The shoes are of such width and number that they cover the entire length of the casing as the shaft revolves. Materials which do not tend to ball up or lump during mixing do not require the attachment of these shoes.

The operation of the machine is as follows: Materials which are to be mixed together are fed into the center opening of the top. The direction of the shaft is such that the paddles tend to move the material to the ends while the scrolls deliver it toward the center, thus producing what is said to be a decided and thorough mixing action. Meanwhile, the shoes rub any lumpy material against the sides of the tank and reduce it to a finely pulverized state. At the end of a predetermined mixing period the bottom gate is opened, and through the conveying action of the scrolls all of the material is discharged.

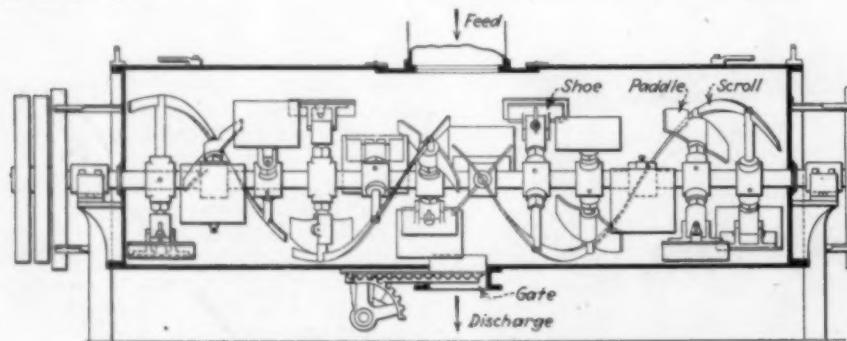
These mixers may be supplied in special metals to meet specific needs, and in sizes ranging from a capacity of 7 cu.ft. upward. They may be provided with a water or steam jacket if necessary. The manufacturer claims more rapid and more thorough mixing than is obtainable by other methods with easy replacement, low maintenance and low power consumption. With the paddles and shoes adjustable, settings may be made to handle a wide variety of dry colors, water paints, stucco, clays, pulverized sugar, soda and other fine materials. It is said that this mixer frequently replaces buhr stones, cage mills, and other comminuting devices.

### Double-Bell Fuel Feed

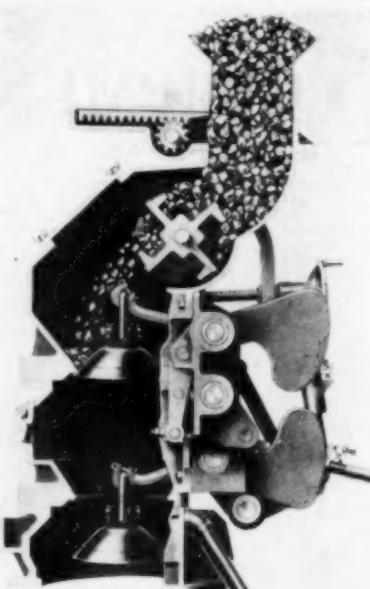
In the accompanying view is shown the new Wellman mechanical double-bell fuel feed as now produced by the Wellman-Seaver-Morgan Co., Cleveland, Ohio. It is intended to supply fuel to gas producers and has been made standard equipment on this company's type L producer.

The operation of the new feed is evidenced in the illustration. The two bells are automatically operated in conjunction with the vane-wheel so that one is tightly closed while the other is open. This construction effectively seals the producer against gas leakage, it is claimed, while at the same time it assures even distribution of the fuel to the producer. The rate of feeding may be regulated by hand, adjusting the movement of the vane-wheel.

One feed only is necessary for each producer. The apparatus is made in two sizes, one handling 5,000 lb. of coal per hour and the other handling a capacity up to 10,000 lb. of coal.



Part Sectional View of Robinson Mfg. Company's New "Unique" Mixer for Dry Materials



New Double-Bell Fuel Feed for Gas Producers

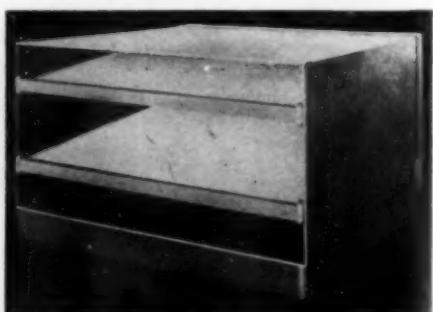
### Cellulose Fiber Mat Air Filter

The National Air Filter Co., Chicago, Ill., has recently adapted cellulose fiber mats for use as filtering mediums in two new types of air filters.

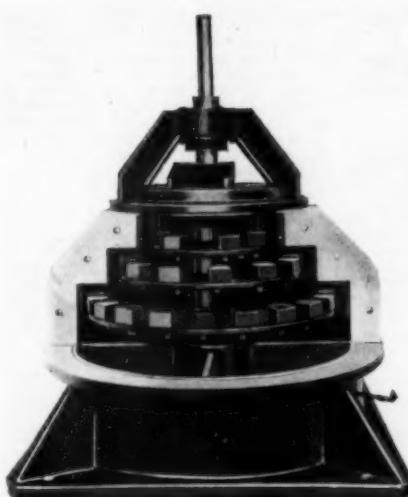
The illustration shown herewith makes clear the principle which is involved in both types of filters. The filter base consists of fluffy cellulose fiber carried between two frames of coarse wire screen which are hinged together at one side to permit renewal of the filtering medium. A new sheet of the cellulose material, "Airmat" which was developed for these filters by the Kimberly-Clark Co., may readily be put into the frames when replacement is required.

The filter unit consists of a sheet metal box 12 in. high x 24 in. wide x 24 in. long, giving a capacity of 1,000 cu.ft. of air per minute. The units may be used singly or in groups to give any desired capacity.

A second type of filter (not shown) uses the same filter medium but renews it continuously and automatically as the filter blanket is fed onto a drum from a continuous roll. As the exposed part of the blanket gradually becomes filled with dirt the pressure head of the air flow automatically actuates the drum and fresh filter blanket is fed in place as the dirty portion is removed.



Cellulose Fiber Mat Air Filter Unit



New Centrifugal Pulverizer

### Centrifugal Hammer Mill

A pulverizer known as the Centri-pact has just been introduced in the East and is being distributed by George F. Pettinos, 1206 Locust Street, Philadelphia, Pa. It is made by the Centri-pact Pulverizer Corporation, Denver, Colo. The mill is shown in the accompanying illustration and consists of three banks of hammers arranged about a vertical axis upon disks of increasing size located within a corrugated housing. The unpulverized material is fed to the center of the top disk where it is thrown by centrifugal force against the hammers and pulverized against the corrugated ring. The fines drop down to the second disk where they are again thrown out by the hammers and drop to the third disk. The discharge from the third disk leaves the mill through a hopper. As each piece of material decreases in size, it is struck an increasing hammer blow, because of the increasing disk diameters.

The maintenance and power costs are said to be very low as the clearances of the machine are  $\frac{1}{2}$  in. or greater. Nevertheless, it is claimed that the machine will pulverize such materials as damp bituminous coal without air separation 90 per cent through 300 mesh. It is said that flint rock has been reduced from  $1\frac{1}{2}$  in. down to 85 per cent through 200 mesh without air separation and that such materials as mica, damp clay, cast iron, shellac, ores, oxides, pigments and so on may be handled. The hammers and breaker rings may be supplied in chilled manganese steel or a special white iron for abrasive materials.



40-Gal. Fused Silica Dish

### Portable Conveyor

The Link-Belt Company, 300 West Pershing Road, Chicago, Ill., has placed upon the market a new portable conveyor, which is known as the "Jax." The conveyor is mounted upon two 14-in. agricultural type wheels which may be moved along the length of the conveyor to adjust the height of the delivery end, or may be used in taking the conveyor from place to place. The conveyor is made in two sizes, one 12 ft. long, weighing 640 lb., and the other 15 ft. long, weighing 710 lb. Both are self-contained and are equipped with skirt boards and anti-friction bearings. The conveyors are adapted to the handling of such material as packages, bags, coal, rock, and similar material.



### Large Fused Silica Pans

Fused silica pans in sizes up to 18 in. in diameter have been used for many years for evaporating solutions of fine chemicals, crystallizing precious metal solutions and for acid concentration. In the latter connection, such pans placed in a series of steps have constituted the cascade concentrator which has practically replaced platinum for the purpose of producing high strength acid of great purity.

However, some demand has always existed for larger receptacles of fused silica which could be employed either individually or in series for handling corrosive liquids at elevated temperatures. The illustration shows the newest type of Vitreosil crystallizing and evaporating pan which has been introduced by the Thermal Syndicate, Ltd., 58 Schenectady Ave., Brooklyn, N. Y. The pan illustrated is 39 in. in diameter and  $7\frac{1}{4}$  in. deep, and holds about 40 gal. It is typical of a line of Vitreosil vessels which may be produced in a variety of areas and depths to order.

These pans are made with substantial walls which give long service even where superficial chemical action may be inevitable with fused silica. In handling sulphuric acid, no corrosion occurs regardless of acid concentration or temperature. This is also true of other non-volatile acids excepting phosphoric. For evaporating and crystallizing solutions of fine chemicals which must be kept free from contamination with iron or other

metallic salts, these large Vitreosil dishes are said to be most suitable. They may be supplied either plain for operation on the batch system or with an overflow lip for operation in cascades. For use at high temperatures, the large size of the dishes necessitates considerable care in supporting. In such cases the manufacturers should be consulted regarding the best practice.

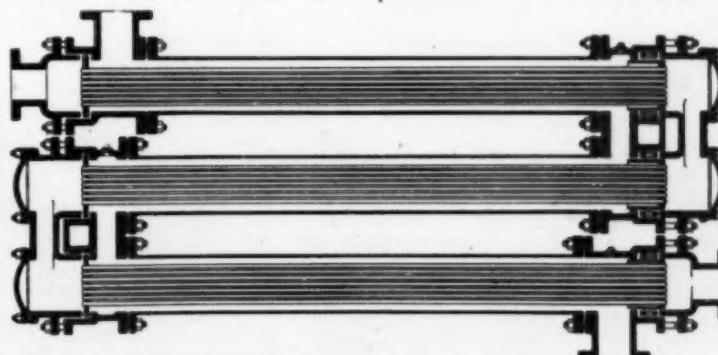
### New Heat Exchanger

A newcomer in the field of multi-pass heat exchangers is the type M. L. heat exchanger announced by the Struthers-Wells Co., Warren, Pa. The new exchanger, illustrated herewith, is made in shell diameters from 8 to 24 inches, and in tube lengths 6 to 20 ft. Larger diameters may be made to order. The exchangers may be furnished in steel, cast iron or various alloys with tubes of steel, brass, copper or alloy. The standard construction permits a working pressure of 125 lb. for both shell and heads, but can be supplied for pressures up to 500 lb. or greater in the shell, and 150 lb. in the heads.

The exchanger is said to be especially adapted for heat exchange between two fluids where a small end temperature difference is required. Any number of units (three are shown in the illustration) may be connected together to give the desired temperature characteristics.

What is said to be an important feature of the construction is the provision for tube expansion with a minimum of packed joints and the prevention of inter-leakage between the two fluids. The stationary tube plate shown at the left of the drawing is packed on either side and tightened by means of the heads. The movable tube plate at the right slides in contact with packing which is separated at its center by means of a circular spiral spring. Leakage passing the packing from either fluid escapes into the space occupied by the spring and thence through a drilled hole from the casing.

Another advantage which is claimed is the elimination of baffling with the possibility of short circuiting. The sections may be arranged with valves and by-passes to cut out any part for cleaning or repairs. In case of accident any tube bundle may be removed and replaced within a short time.



Struthers-Wells Type M. L. Heat Exchanger



Esso Cement Gun

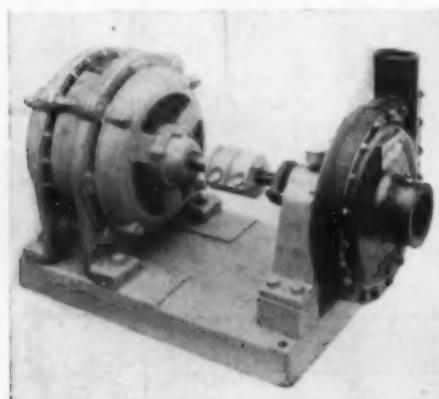
### New Refractory Gun

A new cement gun is the product of the S. Obermayer Co., of Chicago, Ill. This is known as the Esso Cement Gun, and is suitable for maintenance of all refractory surfaces. The capacity of the gun is 20 gal. on one filling, and the gun will operate, it is said, on air pressures as low as 30 lb.

As shown in the accompanying illustration, the gun consists of a 20-gal. brazed tank, from which two 25-ft. lengths of hose lead to a nozzle. Air and cement meet at the nozzle, where the density of the spray may be controlled by the relative proportions of the two components.

### Acid Resisting Pump

A recent development in pumping equipment is the line of hard rubber acid resisting pumps which has been developed by the Bingham Pump Company, Portland, Ore. These pumps are of the side suction, inclosed impeller type, designed for high efficiency. The



Hard Rubber Acid Resisting Pump

entire pump and impeller with the exception of the shaft, which is made of Monel metal, is of rubber molded from polished steel dies which makes the pump capable of handling all acids with the exception of concentrated sulphuric acid.

One of the pumps of the series is shown in the accompanying illustration. Five sizes are manufactured, ranging in capacity from 50 to 300 g.p.m. The manufacturer states that these pumps have been used in connection in a variety of difficult services with the majority handling hydrochloric acid in connection with fruit washing equipment.

### Manufacturers' Latest Publications

**Carrier Engineering Corporation, Newark, N. J.**—A folder announcing the Carrier unit air conditioner.

**Celite Products Company, Los Angeles, Calif.**—Bulletin 337—Covers specifications for the use of Celite in concrete.

**H. A. Robertson Company, 511 Wood Street, Pittsburgh, Pa.**—A folder describing Robertson protected metal.

**Esterline-Angus Company, Indianapolis, Ind.**—Publications as follows: Bulletin 727—"Fairbanks-Morse & Company install modern testing plant," an article. Also a folder on the Esterline-Angus speed recorder.

**Fusion Welding Corporation, 103rd Street and Torrence Avenue, Chicago, Ill.**—A folder concerning Fusion welders.

**John C. Dolph Co., 168 Emmett Street, Newark, N. J.**—"Dolph's Calculating and Solvent Chart" performs calculations for users of insulating varnish.

**The New Departure Manufacturing Company, Bristol, Conn.**—New publications as follows: A-77 revised, a data and telegraph code book giving dimensions, load ratings, and prices for New Departure ball bearings. Folder 31, accuracy of ball bearings.

**Oxweld Acetylene Company, New York, N. Y.**—The "Carbic Light" a booklet describing the uses and operation of the "Carbic" portable floodlight.

**Carrier Engineering Corporation, Newark, N. J.**—Pamphlet describing the new Carrier unit air conditioner.

**Adam Hilger, Ltd., 24 Rochester Place, Camden Road, N.W. 1, England.**—March, 1928 general catalog of the scientific instruments made by this company.

**Sarco Company, Inc., 183 Madison Ave., New York, N. Y.**—New folder describing Sarco steam traps, types S-75 and FT-1. The first is a thermostatic trap, while the second combines a float and thermostatic element.

**A. O. Smith Corporation, Milwaukee, Wis.**—"Four Hundred Engineers and Eight Salesmen,"—some comments on various phases of the activities of the company from the manufacture of automobile frames to pipe line piping and pressure vessels for the chemical industry.

**Webster Tallmadge & Company, Inc., 50 Church St., New York, N. Y.**—"Correct Heating," a brochure discussing a modern system of building heating control.

**W. A. Jones Foundry & Machine Company, 4401 West Roosevelt Road, Chicago, Ill.**—Catalog 36—Prices and specifications of cut herringbone gears.

**Crescent Refractories Company, Curwenville, Pa.**—"Charts, Formulae and Simple Rules," a compilation of this company's bulletins Nos. 1 to 20, Series 1. Contains information and data relative to refractory linings.

**The L. J. Wing Manufacturing Company, 154 West 14th St., New York, N. Y.**—Bulletin 700—Wing turbine blowers for stoker and hand-fired boilers.

**The Aldrich Pump Company, Allentown, Pa.**—Data No. 57—describing "Kosmos" porcelain plungers for pumps subject to corrosion.

**American Electric Motor Company, Cedarburg, Wis.**—Bulletin 102—Fully describes the various types of "American" electric motors.

**U. S. Electrical Manufacturing Company, Los Angeles, Cal.**—Form F526,—The U. S. "AutoStart" Motor.

**Celite Products Company, Los Angeles, Cal.**—Bulletin 101—Data on and applications of Sil-O-Cel insulating materials and their allied products.

**Electric Controller & Manufacturing Company, Cleveland, Ohio.**—A folder describing the component parts of this company's magnetic controller.

**General Electric Company, Schenectady, N. Y.**—Publications as follows: GEA-14 B, automatic switching equipment; GEA-19 B, CR 7006-D4 and D5, a.c. inclosed magnetic switches; GEA-53 B, outdoor switching equipment; GEA-93 B, lightning arresters; GEA-101 B, station oil circuit breakers; GEA-166 A, a.c. crane and hoist motors; GEA-191 A, mechanical drive turbines; GEA-241 A, oil well pumping equipment; GEA-252 A, light-weight type M control system; GEA-360 B, remote-indicating speed controllers; GEA-333 B, low-speed synchronous generators; GEA-402 A, miniature portable instruments; GEA-403 A, drum-type switches; GEA-468 A, drum type controllers; GEA-569 A, constant-potential arc welding sets; GEA-585 A, switchboard recording instruments; GEA-588 A, centrifugal air compressors; GEA-724 A, inclosed fan-cooled induction motors; GEA-743 A, drum controllers; GEA-752 A, shoe-type solenoid brakes; GEA-777 A, vacuum tube synchronizing equipment; GEA-782, outdoor station equipment; GEA-823 A, automatic hydrogen arc welding equipment; GEA-832, portable oil-testing sets; GEA-865, multi-speed induction motors; GEA-874, arc welders; GEA-881, gas engine driven arc welders; GEA-882, electric equipment for plate glass plants; GEA-883, electric equipment for bottle glass plants; GEA-900, test blocks and plugs; GEA-924, switchboard devices; GEA-931, automatic switching equipment; GEA-938, switchboard devices; GEA-941, reciprocating air compressors; GEA-942, switchboard devices; GEA-943, polyphase induction power-directional relays; GEA-949, temperature overload relay panels; GEA-953, steam turbines; GEA-957, mechanical drive turbines; GEA-963, load ratio control equipment; GEA-973, drum controllers; GEA-974, oil circuit breakers; GEA-979, control circuit switches; GEA-980, inclosed speed-regulating rheostats; GEA-981, factory-built complete industrial and small plant switchboards; GEA-988, station oil circuit breakers.

**The Bristol Company, Waterbury, Conn.**—Bulletin 365—A pamphlet describing Bristol revolution and operation counters.

**Johns-Manville Corporation, 292 Madison Avenue, New York, N. Y.**—A booklet describing the use of asbestos insulation for paper machine hoods and housings and for roofs in controlling condensation.

**Combustion Engineering Corporation, 200 Madison Avenue, New York, N. Y.**—Two new article reprints entitled "Design and Application of Traveling Grate Stokers" and "Design and Application of Forced Draft Chain Grates." Also Catalog U-3, describing the "Lopulco" unit system of burning pulverized fuel.

**DeLaval Steam Turbine Company, Tren顿, N. J.**—Bulletin E-1119—"DeLaval Pumps at Spokane, Washington."

**Niagara Concrete Mixer Company, 40 Pearl Street, Buffalo, N. Y.**—A bulletin describing "Niagara" counterflow screens with from one to three decks.

**The Kilby Manufacturing Company, Cleveland, Ohio.**—A folder describing some of the products of this company.

**LaMont Corporation, 200 Fifth Ave., New York, N. Y.**—Two publications as follows: "LaMont Steam Generators" and "LaMont Waste Heat Steam Generators as Applied in the Manufactured Gas Industry."

**Allegheny Steel Company, Brackenridge, Pa.**—Bulletin 4455—Describing the alloys Ascoloy 55 and 44.

**Metropolitan Life Insurance Company, New York, N. Y.**—"The Use of Research in Developing Old Products and Introducing New Ones," a pamphlet prepared for the Research Committee of the New England Council, citing a number of instances where research has been applied to production with considerable advantage.

**Taber Pump Company, 288 Elm St., Buffalo, N. Y.**—Bulletin SEW-628—Describes pumps intended exclusively for handling sewage.

**The Ludlow-Saylor Wire Company, St. Louis, Mo.**—"Controlling Crusher Waste with Woven Screens." This is Section 1 of the large Catalog No. 48 previously announced.

**Riley Stoker Corporation, Worcester, Mass.**—New catalog describing the Riley "Atrita" unit pulverizer.

**The Schutte & Koerting Company, Philadelphia, Pa.**—Bulletin 6-D revised—The construction of desuperheaters and the advantages of desuperheating steam for certain process uses.

**Crouse-Hinds Company, Syracuse, N. Y.**—Bulletin 2111—Plugs and receptacles for portable electric apparatus.

**The Esterline-Angus Company, Indianapolis, Ind.**—Bulletin No. 328—"The Uses of Speed Recorders."

**Sumit-Solvay Engineering Corporation, 40 Rector St., New York, N. Y.**—Pamphlet 347—Steere water gas machines.

# PATENTS ISSUED

## May 8 to May 29, 1928

### PAPER, PULP, GLASS AND SUGAR

**Paper-Mill Sludge Composition.** August E. Hansen, New York, N. Y., and Albert C. Ruger, Wollaston, Mass.—1,668,961.

**Plastic composition.**

**Paper-Drying Machine.** Michael J. O'Malley, Chicago, Ill.—1,669,774.

**Glass Furnace and Leer.** Julius H. O. Bunge, London, England, assignor to Hartford-Empire Company, Hartford, Conn.—1,669,968.

**Method and Apparatus for Producing Pressed Sheet Glass.** Frank Fraser, Toledo, Ohio, assignor to The Libbey-Owens Sheet Glass Company, Toledo, Ohio.—1,670,110.

**Paper-Drying Machine.** Albert Dex Harrison, Montreal, Quebec, Canada.—1,670,113.

**Beater for Paper-Making Machines.** John Simpson Beck, Manville, N. J.—1,670,183.

**Juice Filter.** Arthur J. Rechlin, Bay City, Mich.—1,670,482.

**Means for Reclaiming Suspended Solids from White Water of Paper Manufacture.** Albert Bankus, Portland, Ore., and George S. Backus, San Francisco, Calif.—1,670,874.

**Acid Proportioning and Control System for Sulphite Mills.** Charles Oland Sister, Sault Ste. Marie, Ontario, Canada.—1,671,656.

### RUBBER, RAYON AND SYNTHETIC PLASTICS

**Method for the Dispersion of Rubber into Coloidal Substance.** Harlan L. Trumbull, Hudson, Ohio, and John B. Dickson, Northampton, Mass., assignors to The B. F. Goodrich Company, New York, N. Y.—1,668,879.

**Process of Making Cellulose Acetate.** Harry Le B. Gray and Cyril J. Staud, Rochester, N. Y., assignors to Eastman Kodak Company, Rochester, N. Y.—1,668,959.

**Treatment of Fatty Still Residues.** Wallace Savage, Elizabeth, N. J., assignor to Savage-Rubber Corporation, Newark, N. J.—1,669,491.

**Method of Producing Carbon Black.** Warren K. Lewis, Newton, Mass., assignor to The Goodyear Tire & Rubber Company, Akron, Ohio.—1,669,618.

**Phenol Resin and Method of Making the Same.** Charles J. Romieux, Elizabeth, N. J., assignor to American Cyanamid Company, New York, N. Y.—1,669,674.

**Method of Producing Artificial Resin.** Carl Kulas, Leipzig, Germany.—1,669,831.

**Process of Producing Rubber-Like Bodies.** William Beach Pratt, Wellesley, Mass., assignor, by mesne assignments, to Dispersions Process, Inc., Dover, Del.—1,671,314.

**Method of Reclaiming and Dispersing Vulcanized Rubber.** Thomas G. Richards, Cambridge, and George P. F. Smith, Newton, Mass., assignors, by mesne assignments, to Dispersions Process, Inc., Dover, Del.—1,671,316.

**Resinous Reaction Product of Urea and Formaldehyde.** Felix Lauter, Philadelphia, Pa., assignors to Rohm & Haas Company.—1,671,596.

### PETROLEUM REFINING AND PRODUCTS

**Process for Distilling Mineral Oil.** Arthur E. Pew, Jr., Bryn Mawr, and Henry Thomas, Ridley Park, Pa., assignors to Sun Oil Company, Philadelphia, Pa.—1,668,602.

**Oil - Field - Emulsion Treating Means.** Frank Gardner, Dallas, Tex.—1,668,766.

**Apparatus for Extracting Oil from Shale.** William Rhoades, San Leandro, Calif., assignor, by direct and mesne assignments, to Rhoades Shale Oil Company.—1,668,820.

**Oxidation of Hydrocarbons.** Joseph R. Scanlin, Port Arthur, Tex., assignor, by mesne assignments, to The Texas Company, New York, N. Y.—1,668,871.

**Process for Recovery of Sulphuric Acid from Acid Sludges.** Jan D. Ruys, Wilmington, Calif., assignor to Shell Company of California, San Francisco, Calif.—1,669,102.

**Refining Hydrocarbon Oils.** Paul McMichael, Flushing, N. Y., assignor to Hydrocarbon Refining Process Co., Inc., New York, N. Y.—1,669,944.

**Art of Heat Conversion of Hydrocarbon Oils.** Frank A. Howard and Nathaniel E. Loomis, Elizabeth, N. J., assignors to Standard Oil Development Company, Elizabeth, N. J.—1,670,037.

**Oil Treatment.** Carbon P. Dubbs, Wilmette, Ill., assignor to The Universal Oil Products Company, Chicago, Ill.—1,670,103-8.

**Dephlegmator.** Herbert S. Mabey, Chicago, Ill., assignor to Universal Oil Products Company, Chicago, Ill.—1,670,118.

**Refluxing Tower.** Roy Cross, Kansas City, Mo., assignor to Gasoline Products Company, Inc., New York, N. Y.—1,670,762.

**Process for Catalytic Cracking of Heavy Hydrocarbons, Mineral Oils, Oil Residue, Tars and the Like.** Edgar Erlenbach, Berlin, Germany, assignor of one-fourth to Sinclair Refining Company, Chicago, Ill.—1,671,573.

### COAL PROCESSING AND COMBUSTION

**Manufacture of Fuel Briquettes.** Alice Marion Hart, London, England, assignor to Hart Carbon Fuel Company Limited, London, England.—1,668,643.

**Method of Treating Pulverized Vegetable Fuels.** Saichi Shimamoto, Tokyo, Japan.—1,668,660.

*Sawdust briquettes.*

**Treatment of Solid Bituminiferous Material.** William Huntley Hampton, New York, N. Y.—1,668,898.

**Carbonization of Coal.** Walter Runge, East Orange, N. J., assignor, by mesne assignments, to International Coal Carbonization Company.—1,669,023.

**Coking Oven.** Hans Heinrich Koppers, Essen-Ruhr, Germany.—1,669,168.

**Process for Making Producer Gas.** Henry L. Doherty, New York, N. Y.—1,670,102.

**Process for Coke-Oven Heating and the Like.** Heinrich Koppers, Essen-Ruhr, Germany, assignor to The Koppers Development Corporation, Pittsburgh, Pa.—1,671,194.

**Retort Oven.** Heinrich Koppers, Essen-Ruhr, Germany, assignor to The Koppers Development Corporation, Pittsburgh, Pa.—1,671,195.

**Retort for Carbonizing Bituminous Fuels.** Josef Plassmann, Duisburg, Germany.—1,671,448.

**Method of Calcining Coke.** Victor C. Doerschuk, Massena, N. Y., and Francis C. Frary, Oakmont, Pa., assignors to Aluminum Company of America, Pittsburgh, Pa.—1,671,673.

### ORGANIC PROCESSES

**Normal Tributyl Borate.** William J. Banister, Terre Haute, Ind., assignor to Commercial Solvents Corporation, Terre Haute, Ind.—1,668,797.

**Dehydrating Alcohol.** John A. Steffens, Brooklyn, N. Y.—1,670,053.

**Process for the Preparation of Urea from Carbonic Anhydride and Synthetic Ammonia.** Luigi Casale, Rome, Italy; Marie Casale Sacchi administratrix of said Luigi Casale, deceased.—1,670,341.

**Process of Preparing H-Acid.** Ivan Gubermann and John M. Tinker, South Milwaukee, Wis., assignors to The Newport Company, Carrollville, Wis.—1,670,406.

**Manufacture of Side-Chain Aromatic Compounds.** Fritz Günther, Ludwigshafen-on-the-Rhine, Germany, assignor to Graselli Dyestuff Corporation, New York, N. Y.—1,670,505.

**Process and Apparatus for Converting Carbohydrates.** Rudolph Alfred Kocher, Ypsilanti, Mich.—1,670,727.

**Method of Producing a Solution of Cyanamide from Calcium Cyanamide.** Albert N. Erickson, Elmhurst, N. Y., assignor to Union Carbide Company.—1,671,183.

**Catalyzer for Manufacture of Light Hydrocarbons.** Lazar Edelenau, Berlin-Charlottenburg, Germany, assignor to Allgemeine Gesellschaft für Chemische Industrie, Berlin, Germany.—1,671,517.

**Treatment of Crude Cottonseed Oil.** David McNicoll, Kingston-upon-Hull, England, assignor to The British Oil and Cake Mills Limited, Kingston-upon-Hull, England.—1,671,834.

### INORGANIC PROCESSES

**Cementitious Material.** Harry E. Brookby, Chicago, Ill., and Carlisle K. Roos, Fort Dodge, Iowa, assignors to United States Gypsum Company, Chicago, Ill.—1,668,548.

**Zinc Oxide Catalysts.** Grover Bloomfield, Terre Haute, Ind., assignor to Commercial Solvents Corporation, Terre Haute, Ind.—1,668,828.

**Process of Generating Foam from Foaming Substances.** Rudolf Schnabel, Berlin, Germany, assignor to Minimax Act-Ges., Berlin, Germany.—1,669,213.

**Crude Lithopone and Improved Method of Manufacturing the Same.** John H. Calbeck, Joplin, Mo., assignor to The Eagle-Picher Lead Company, Cincinnati, Ohio.—1,669,857.

**Persalts and Process of Making the Same.** Friedrich Noll, Benrath, Germany—1,669,997.

*Non-alkali metals.*

**Extraction of Krypton and Xenon from Air.** Auguste Jules Adrien Blaringhem, Mazingarbe, France, assignor to Société Anonyme d'Eclairage et d'Applications Electriques, Arras, Pas-de-Calais, France.—1,670,014.

**Manufacture of Zinc Oxide.** James A. Singmaster, Bronxville, N. Y., and Frank G. Breyer and Earl H. Bunce, Palmerton, Pa., assignors to The New Jersey Zinc Company, New York.—1,670,169.

**Cooling and Drying Apparatus and Process of Cement Making Adapted to be Carried on Thereby.** Hugo O. Moebius, Hanover, Germany, assignor to American Miag Corporation, Buffalo, N. Y.—1,670,269.

**Manufacture of Di-Ammonium Phosphate.** Robert Griessbach, Otto Balz, and Adolf Rössler, Ludwigshafen-on-the-Rhine, Germany, assignors to I. G. Farbenindustrie Aktiengesellschaft, Frankfort-on-the-Main, Germany.—1,670,504.

**Method of Preparing Antimony Sulphide.** Hans Nuhn, Karlsruhe, Germany, and Lewis H. Blood, Matawan, N. J., assignors to Antimony Products Corporation, New York, N. Y.—1,671,203.

**Globular Sodium Bisulphate and Method of Making the Same.** Clarence P. Linville, Elizabeth, and Carl E. Mensing, Somerville, N. J., assignors to Calco Chemical Company, Bound Brook, N. J.—1,671,866.

### CHEMICAL ENGINEERING PROCESSES AND EQUIPMENT

**Gyratory Crusher.** William S. Weston, Columbia, S. C.—1,667,337.

**Mechanism for Actuating the Gates of Gravity Discharge Hoppers.** William J. Burnett, Glenside, Pa., assignor to Beaumont Manufacturing Company, Philadelphia, Pa.—1,667,468.

**Antifriction Agitator.** John Benjamin Hinshaw, Topeka, Kan.—1,667,551.

**Liquid and Gas Contact Apparatus.** Frederick H. Wagner, Baltimore, Md., assignor to The Bartlett Hayward Company, Baltimore, Md.—1,669,638, 1,669,795.

**Apparatus for and Method of Tanning Hides.** Matthew M. Merritt, Middleton, Mass., assignor, by mesne assignments, to United Shoe Machinery Corporation, Paterson, N. J.—1,668,652.

**Method and Apparatus for Effecting Rapid Drying Operations.** George L. Clark, Arlington, Mass., assignor to Nashua Gummed & Coated Paper Company, Nashua, N. Y.—1,668,943.

**Drier.** Otto Nordström, Sundsvall, Sweden.—1,669,012.

*Continuous vertical drier for granular material.*

**Heating Kiln.** Boyd M. Johnson, Metuchen, N. J., assignor to The Carborundum Company, Niagara Falls, N. Y.—1,669,563.

**Tunnel Kiln.** John B. Owens, Tampa, Fla.—1,669,777.

**Method and Means for Effecting the Separation of Subdivided Materials.** Richard F. Grant, Bratenahl, Ohio, Edward B. Worthington, Forty Fort, and William L. Jacobus, Wilkes-Barre, Pa., assignors to Susquehanna Collieries Company, Wilkes-Barre, Pa.—1,669,820.

*Vortex separation.*

**Roasting-Furnace Construction.** Dudley Baird, Berkeley, Calif., assignor to Nichols Copper Company, New York, N. Y.—1,669,925.

**Electrode Mass for Self-Baking Electrodes.** Carl Wilhelm Söderberg, Oslo, Norway, assignor to Det Norske Aktieselskab for Elektrokemisk Industri of Norway, Oslo, Norway.—1,670,052.

**System of Fluid-Pressure Regulation.** Walter L. Oswald, Mount Vernon, N. Y., assignor, by mesne assignments, to Cutler-Hammer Manufacturing Company.—1,670,313.

**Apparatus for Filtering.** Ernest J. Sweetland, Hazleton, Pa.—1,670,319.

**Mixing Machine and Process.** Stuart P. Miller, Philadelphia, Pa., assignor to The Barrett Company.—1,670,593.

**Apparatus for Separating Liquids of Different Specific Gravities.** Wilhelm Linnemann, Jr., Essen-Altenessen, Germany.—1,671,115.

**Multi-Chamber Mill for Grinding Materials of All Kinds.** Johannes Ihlefeldt, Dessau, Germany.—1,671,291.

**Dryness Controller.** Stephen A. Staeg, Pittsburgh, Pa., assignor to Westinghouse Electric & Manufacturing Company.—1,671,493.

**Apparatus for Removing Gases from Liquids.** Louis D. Mills, Palo Alto, Calif., assignor to The Merrill Company, San Francisco, Calif.—1,671,601.

# NEWS of the Industry

## Rubber Institute Formed By Manufacturers

LEADING tire manufacturers and companies representing different branches of rubber manufacture have organized a Rubber Institute. General Lincoln C. Andrews formerly assistant secretary of the treasury will head the institute as its director general. The institute was organized to promote in the industry a mutual confidence and a high standard of business ethics; to eliminate trade abuses; to promote sound economic business customs and practices; to foster wholesome competition; to provide ultimately for individual efficient business management, operating independently, an opportunity to do business with an adequate return; and thus generally to promote the service of the industry to the public welfare.

At the first meeting held at the Plaza Hotel, New York, on June 1, 15 directors of three classes were elected. The first class, composed of representatives of companies having annual sales of over \$50,000,000, includes H. S. Firestone, president of Firestone Tire & Rubber Co.; H. T. Dunn, president of Fisk Rubber Co.; P. W. Litchfield, president of Goodyear Tire & Rubber Co.; C. B. Seger, president of U. S. Rubber Co., and J. D. Tew, president of B. F. Goodrich Co.

Representatives of the second class, which includes companies with annual sales of from \$10,000,000 to \$50,000,000, are A. F. Townsend, of Manhattan Rubber Manufacturing Co.; F. C. Hood, of Hood Rubber Co.; W. O'Neil, of General Tire & Rubber Co.; Samuel Woolner, of Kelly-Springfield Tire Co., and F. A. Seiberling, of Seiberling Rubber Co.

The third class, including representatives of companies whose annual sales are less than \$10,000,000, consists of A. B. Cornell, E. A. Boyer, Thomas Matchett, C. D. Garretson and C. S. Dickey.

## Government Tests Locate Potash in Texas

ANOTHER substantial find of potash discovered through governmental agencies was made public by the Interior Department on May 28. The Geological Survey has recently completed its analyses of cores received from four test wells drilled by the Bu-

reau of Mines under the potash act, which provides for joint explorations by the Department of the Interior and the Department of Commerce. In the interval between the depths of 1,935 ft. 7 in. and 1,945 ft. in well No. 4, drilled in southwestern Ector County, Tex., are two potash beds that have a combined thickness of 6 ft. 7 in. and together contain 12.86 per cent of potash ( $K_2O$ ) in the sample as received, equivalent to 18.98 per cent in the soluble salts.

## Standard Oil to Experiment With Bergius Process

THE Standard Oil Company of New Jersey has acquired the American rights to the Bergius process for the extraction of benzol from coal. Extensive experimental work will be carried on at a laboratory established at Baton Rouge, La. The domestic company will work jointly with I. G. Farben Industrie of Germany in this country. There is no expectation of producing the fuel on a commercial scale in the near future. With the present overproduction of petroleum no need for the new process fuel is seen, nor is it expected to develop for some years.

Under the process, production is not so economical as that of producing gasoline from crude petroleum, and as long as this condition prevails, no use of the new process commercially is looked for. Plans are being made in expectation of an ultimate demand for the process.

## Tartaric Acid Tariff Hearing Postponed

At a meeting held June 8 the United States Tariff Commission decided to postpone from July 14 to July 25 the public hearings in the cost of production covering cream of tartar and tartaric acid, according to an oral announcement from the Commission.

The request for a postponement came originally from the Italian Government through its ambassador in Washington, it was announced. The Commission explained, however, that there was no objection to the postponement of the hearing on the part of domestic producers.

## European Scientists Will Attend Coal Conference

BETWEEN 60 and 70 scientists and fuel technologists in eleven different countries, it is announced, have tentatively accepted invitations to speak at the Second International Conference on Bituminous Coal which will be held at the Carnegie Institute of Technology in Pittsburgh, Pa., during the week of November 19, 1928. The list includes about forty Europeans whom Dr. Thomas S. Baker, president of the Carnegie Institute of Technology, personally invited while making his recent two-month's visit in Europe in the interests of the coal conference.

Among the distinguished scientists in Europe who have either definitely or tentatively accepted invitations to speak at the second congress are the Right Honorable Sir Alfred Mond, Harald Nielsen, Dr. Cecil H. Lander, and Dr. R. Lessing, of England; Donat Agache, president of the executive board of the Kuhlmann plants, Andre Kling, director of the Municipal laboratories of Paris, and Henri Lafond, International Company for the Manufacture of Gasoline and Oils, France; Dr. Friedrich Bergius, inventor of the Bergius process for the production of oil from coal, Dr. Franz Fischer, director of the Kaiser Wilhelm Institute for Coal Research, Professor Fritz Hoffman, inventor of a process for manufacturing synthetic rubber from coal, Dr. Carl Krauch, director of the I. G. Dye Trust, and Rudolph Rawikowski, of the Cosmos Machine Construction Institute, Germany.

## Lime Association Creates Control Committee

AT ITS meeting of May 23-24 in New York, the National Lime Association carried somewhat further its recent policy of curtailment of certain and the intensification of other of its activities. With this object in view, it created an executive committee of five members in whose hands the active control of the Association is to be centered. Those who were elected to the committee were: J. L. Durnell, J. M. Deeley, A. B. Mack, J. M. Gager, and H. B. Mathews. Ralph Wilton was elected treasurer. The resignation of G. B. Arthur, general manager of the association was tendered and accepted.

## Fertilizer Association Plans Many New Activities

Reports Show That Current Season Was a Financial Success

OVER 500 persons participated in the annual meeting of the National Fertilizer Association, June 11-14, at Old Point Comfort, Virginia. Numerous evidences were given of the renewed optimism of the industry, but none more striking than the decision to raise the dues of the member companies to four cents per ton of fertilizer, thus restoring the rate which prevailed previous to the last year of depression. An enlarged budget will be possible with the increased dues, and it is hoped that the association can take up actively some of the projects which have been held in abeyance because of the lack of funds in the past year. The work of the association during the coming year will be under the same officers, as all were re-elected for another term.

Three important decisions were reached officially regarding fertilizer nomenclature. The association officially confirmed the earlier recommendations of its officers and committees for the use of the term super-phosphate to replace the term acid phosphate. The association confirmed the recommendation of the board of directors that analyses of fertilizer be stated in terms of nitrogen instead of ammonium. The practice of reporting analyses in the order nitrogen, phosphoric acid, and potash was officially recommended and the association went on record in favor of this system as a uniform procedure for the entire country.

**C**ONCERTED action of the fertilizer industry for promotion of sound trade practices, for self-defense by the industry, and for promotion of business by co-operative advertising, was set as the most important objective by the presidential address of E. L. Robins.

As definite recommendations, which received favorable support, President Robins advocated substitution of the name "superphosphate" for acid phosphate; designation of nitrogen instead of ammonia content of fertilizers; statement of analyses in the order, phosphoric acid first, nitrogen second, and potash third; and expression of composition guarantees in whole units only, with omission of all fractional percentages.

The very vigorous effort made in opposing government manufacture of fertilizer at Muscle Shoals not only has demonstrated the ability for joint effort within the industry, but has created a strong appreciation for the need of co-operative industry advertising. Considerable enthusiasm was, therefore, evident in support of the proposed national advertising campaign. The most specific recommendations were made by Ernest E. Dallis, of Johnson-Dallis Company, Atlanta, who cited the successful industry advertising of

numerous other groups. He recommended an assessment of five cents per ton of fertilizer sold, approximately one-sixth of one per cent of the gross sales price, in order to raise annually a fund of \$350,000 for a three-year to five-year advertising program to exploit the industry.

**F**IGURES indicate, according to executive secretary Charles J. Brand, that the industry's operating loss, which exceeded \$22,000,000 in 1926-27, was turned into a fair profit during the current fertilizer year. Principal credit is given to increased sales, and it is anticipated that a vigorous advertising program, conducted on a long-time basis, will further aid in this direction. Some credit for the improved financial condition of the industry was also given by both President Robin and Secretary Brand to improved marketing conditions because of widespread observance of the industry's Code of Trade Practices. Mr. Robins stated that "in certain sections the observance has been almost 100 per cent and the results have been admirable."

Cost accounting according to proper methods is on the increase, according to the paper presented by William B. McCloskey, cost accountant of the association, who reported that more than 30 member companies have already definitely committed themselves to the use of the uniform system of accounting recommended. Examples cited by Mr. McCloskey show, however, that there still remain wide discrepancies in practice. He cited one case where selling expense and administrative expense were respectively two and one-quarter and one per cent of factory cost for one reporting company; whereas another concern having approximately the same factory cost reported these two items as 21.5 and 10 per cent respectively. Obviously the actual differences in costs are nothing like as great as this; the apparent differences are largely due, according to Mr. McCloskey, to faulty accounting methods in one or both companies' plants.

**F**. G. Cottrell, chief of the fertilizer and fixed nitrogen investigations of the U. S. Department of Agriculture, presented a historical and technical discussion in the "Present Status and Future Outlook in Nitrogen Fixation." He pointed out that direct synthetic ammonia processes were the first industrial developments to threaten complete over-thrown of Chilean nitrate in the domination of world nitrogen prices. All other systems of nitrogen supply previously developed have in some measure lacked the magnitude or freedom of unlimited development which would enable independent fixing of nitrogen prices. The direct synthetic

processes with proper further industrialization are, according to Mr. Cottrell, not so limited. It is forecast that the "nitrogen problem has come to revolve about fuel in general and coal in particular" and that synthetic products are now unlimited by any consideration of location of raw materials, since air, water, and coal are almost universally available. This means that Chilean nitrate production will not necessarily cease, or even be greatly reduced, but that continued marketing of Chilean nitrate with profit will require the steady betterment of production processes in order that costs may become as low as possible.

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### Institute of Chemistry Will Open July 23

The second session of the Institute of Chemistry of the American Chemical Society will open on July 23 at Evans-ton, Ill. There will be a garden party in the afternoon in special honor of the president of the American Chemical Society, S. W. Parr, professor emeritus at the University of Illinois, Dr. Charles L. Parsons, secretary of the American Chemical Society, and Dr. Harrison E. Howe, editor of *Industrial and Engineering Chemistry*.

The list of speakers who have accepted invitations to speak during the sessions which will continue from July 23 to Aug. 18, includes leading scientists and industrialists of the country.

**A**MONG some of the speakers are Dr. A. C. L. Gabriel, vice-president of the Commercial Solvents Corporation, who will discuss the development of the fermentation industry, by which corn is converted into butanol and acetone at two large plants at Peoria and Terre Haute.

James Slayter, President of the Kalkite Company, will discuss "The Preparation of Useful Products from Corn Cobs."

C. S. Miner will discuss the general subject of "The Manufacture of Useful Products from Waste Materials such as Oat Hulls." Dr. E. C. Lathrop, of the Celotex Company, will give a talk on "Celotex" illustrated by motion pictures. Dr. A. W. Schorger, of the C. F. Burgess Laboratories, Madison, Wisconsin, will take part in the discussion of "The Chemistry of Cellulose." G. A. Richter, director of research of the Brown Company, Berlin, N. H., will discuss "The Preparation of Alpha Cellulose from Wood Pulp."

Dr. H. A. Curtis, head of the chemical engineering department at Yale University, will give a talk at the Institute covering his impressions on "The Cruise of the Lützow and the World Nitrogen Situation." Thomas Midgley, Jr., will discuss the present status of artificial rubber. Mr. Midgley is best known for his discovery of the valuable properties of lead tetra-ethyl. He is now devoting his attention to the problem of the commercial synthesis of rubber.

## Technical Papers Featured London Chemical Conference

### Progress of Association Activities Reviewed at Annual Meeting

THE joint London Conference, organized by the Society of Chemical Industry in conjunction with the London Section and Chemical Engineering Group together with the Institution of Chemical Engineers, was held at London, May 11-15.

The conference started on the morning of May 11 with a meeting of chairmen and secretaries of local sections of the Society of Chemical Industry. The report of the committee showed a membership gain during the year and reviewed the progress attained in association activities. In the evening the annual meeting and dinner of the Chemical Engineering Group were held. F. H. Carr was the principal speaker of the evening. He first referred to the synthetic production of vitamin D, in the manufacture of which he had played an important part. He followed with a demonstration with a mercury vapor lamp, showing the use to which it could be put, through the agency of fluorescence, in detecting impurities in various substances. Paraffin wax, table jellies, zinc white, eggs, artificial and natural silk, and a number of other substances were placed under the influence of the ultra-violet rays from this quartz lamp. In the case of eggs it was pointed out how the age of them could be determined, whether silk was artificial or natural, how in the case of table jellies the spores of bacteria could be detected, and as regards chemicals how impurities in them are immediately revealed.

May 12 was devoted to an all-day visit to Rothamsted Experimental Station and through the courtesy of Fellows of the Zoological Society, the Zoological gardens were placed at the disposal of the members on Sunday, May 13.

TECHNICAL papers featured the sessions beginning May 14 and held at the Institution of Civil Engineers. Sir Hugo Hirst presided at the session and explained the conference was being held as a gentle reply to the allegation or reproach by Lord Balfour as regards the chemical industry of this country. Lord Balfour did not seem satisfied, that the chemical industry had pulled its full weight. That allegation had also been made against the electrical industry, in which he himself was engaged. So far as pure science was concerned he stated that English scientists were not behind any other country in the world but so far as the application of chemical science was concerned there was a tremendous amount of work to be done, and that involved linking up with the physicist, the metallurgist and the engineer. It seemed to him that the task that the country expected the chemical engineer to solve was to install King Coal in his old might and power. It was the only raw material on which

home industries could be built up and it was necessary to build up these industries because of the impossibility of keeping 45 millions or 50 millions of population alive unless industries are so efficient that they can export. There would have to be co-operative work to solve this great problem.

Sir Arthur Duckham was to have read the first paper but was prevented, through illness, from attending and Dr. E. W. Smith read his paper which was on "The Fuel Industries and the Work of the Chemical Engineer." He was followed by Prof. G. T. Morgan who spoke on "The Chemical Study of Low-Temperature Tar." The latter paper was a review of the progress made in research work on tar and tar distillates at the Chemical Research Laboratory.

AT THE morning session on May 15, Sir Ernest Rutherford presided. Sir Alfred Mond spoke at some length on "Scientific Research as Applied to Industry." In his address he referred to catalysis which, he said, had become the handmaiden of very many industries, and when it was combined, as had been done, with high temperatures and high pressures, it was difficult to say where the chemist began, the engineer ends, or where the physicist is installed. As a matter of fact, co-operation of all three was required if they were to obtain the fullest knowledge on this subject. Then there was also the bio-chemist, who was beginning to loom large in modern industrial chemistry, and especially in the great fermentation industries and bacteriological processes. Again, there was the fine chemical industry, and looking into the details he did not think we have

any reason to be ashamed of the work that has been done or the work that is in progress in all these directions. Surveying the whole field, it could be said with confidence that as far as the present position of chemical industry is concerned it could claim an equality—he did not claim any more—with the chemical industries of any other country in the world. There was a national responsibility attaching to chemical industry which did not apply to any other industry.

UNDER direction of H. T. Tizard the final session was featured by a paper on "Development in the Heavy Chemical Industry" delivered by Lieut.-Col. G. P. Pollitt. He traced the development in the industry during and since the war. After discussing processes which depend on high pressures he referred to the cellulose industry. He stated that apart from paper, cellulose did not enter largely into the chemical industries before the war. Beginnings had been made with nitrated compounds for explosives, and the artificial silk industry was engaged in its early struggles, but there were few signs of the magnitude of present developments. The artificial silk industry, and particularly the viscose process, which was at present by far the most important, arose as a direct consequence of the work of Cross and Bevan on cellulose. The production figures of the artificial silk industry were comparable with those for nitrogen. In 1913 13,000 tons of artificial silk were produced, in 1927 approximately 135,000 tons, and in this industry Great Britain both in research and commercial development had led the world. Nitrate cellulose had found entirely new uses quite outside the production of explosives. America was responsible for this development, and the production by it of nitro-cellulose lacquers and leather cloth was having a profound effect on the motor car industry.



A British Chemical Industry Group

Standing—Dr. J. P. Longstaff, W. J. U. Woolcock, Dr. Stephen Miall, Julian L. Baker. Seated—F. E. Hamer, C. A. Hill, H. C. Parmelee, Francis H. Carr, Dr. E. W. Smith.

# NEWS FROM WASHINGTON

By Paul Wooton

Washington Correspondent of Chem. & Met.

**T**HE MUSCLE SHOALS bill, as passed by Congress on May 25, failed to become operative because President Coolidge withheld his signature which action, after midnight June 7, constituted a pocket veto. The bill as finally approved by the House and the Senate authorized the formation of a corporation under direction of a Board of three members. This Board was given authority to operate existing plants for experimental purposes, to build new experimental plants at Muscle Shoals for manufacture of fertilizer or any ingredients for experimental purposes, and to contract with commercial producers for production of other ingredients needed in the government's program of development and introduction.

It authorized the Board to arrange with farmers for large-scale practical use of the new fertilizers. Donation of one per cent of production was prescribed for distribution through county demonstration agents and agricultural colleges for experimentation and to further the use of such products in co-operation with practical farmers.

**P**ROVISIONS of the bill directed the Board to make fixed nitrogen by use of existing facilities or by modernizing them or by the use of any process, the nitrogen to be in such form and in combination with such other ingredients as shall make such nitrogen immediately available and practical for use by farmers in application to soil and crops. The production and sale of electric power also were provided for.

Net proceeds derived from the sale of power and any of the products manufactured by the corporation, after deducting the cost of operation, maintenance, depreciation, and an amount deemed by the Board as necessary to withhold as operating capital, were ordered paid into the treasury of the United States at the end of each calendar year.

One section of the bill gave the corporation access to Patent Office for the purpose of studying, ascertaining, and copying all methods, formulae, and scientific information necessary to enable the corporation to use and employ the most efficacious and economical process for the production of fixed nitrogen. Any patentee whose patents are thus employed may sue the corporation for compensation in the appropriate district court of the United States.

**O**VERPRODUCTION in the chemical industry is becoming more pronounced. The situation, already regarded as serious, promises to enter a more aggravated stage in the not distant

future. Price cutting is much in evidence and is likely to become rampant. Production capacity in a wide variety of chemical commodities is greatly in excess of present requirements.

Similar situations are being improved in other industries by consolidations, but there has been relatively little activity to that end in chemical manufacture. Thought in the industry, however, is running along those lines and a greater tendency toward centralization is expected by those who have broad contacts with the industry.

Chemical manufacturers and wholesalers have been particularly enterprising in trying to reduce excess variety in the standardization of their product and in adopting the most improved practices in production and marketing. No industry spends a greater proportion of

## Chem. & Met. Protests Muscle Shoals Bill

Hon. Calvin Coolidge,  
Executive Offices,  
Washington, D. C.

*Chemical & Metallurgical Engineering* respectfully protests Federal participation in either fixed nitrogen or complete fertilizer manufacture as provided in pending Muscle Shoals legislation. Firmly believing that your stated views and consistent opposition to Government ownership and operation of private enterprise will lead you to veto this dangerous measure we would nevertheless call your attention to the fact that if passed the Muscle Shoals bill would paralyze an important branch of chemical industry only now ready for large scale development after ten years of scientific research by university, governmental and private laboratories. Present plans for producing fertilizer material by at least two of the seven American fixed nitrogen manufacturers may have to be abandoned at great loss to both industry and agriculture if Government enters into competition through control and subsidized operation of Muscle Shoals plants. Therefore we strongly urge that this bill be returned to Congress with your request to eliminate all provisions for Government operation in producing fixed nitrogen, phosphoric acid, potash and by-products as well as complete fertilizers.

Chemical & Metallurgical  
Engineering

its gross receipts on research. It has accomplished wonders in the elimination of waste, in the finding of uses for by-products and in devising new uses for many of its commodities. Increased efficiency, however, has increased output and as a consequence observers in Washington view the future with a considerable amount of apprehension.

**T**HE rapid progress of chemical development has the disadvantage of contributing some instability. Discovery of new methods or the improvement of old ones frequently have far-reaching effect. There are so many thousands of chemical commodities that the extent and the frequency of these changes is not generally recognized.

In this connection there is a demand from the industry for a more systematic study of foreign patents. Under reciprocal agreements most foreign governments send copies of applications for patents to the U. S. Patent Office. Were these patents scrutinized carefully it is believed that American industry frequently could be warned well in advance of impending improvements likely to affect or possibly revolutionize their business.

Because of the newness of the industry little exact information is available concerning the plastic paint industry. It is known that a business of \$5,000,000 has been built up in four years. Interior decoration is being revolutionized and a large amount of wall paper displaced. To provide more data concerning this product the Chemical Division of the Bureau of Foreign and Domestic Commerce is sending out a questionnaire.

Another questionnaire is being sent to manufacturers of polishes. American shoe polishes for a number of years have held a dominant place in world trade. It is the belief at the Chemical Division that American furniture, metal, floor, automobile and other polishes can be sold in much larger quantities abroad. With that in view the division is collecting the necessary data preparatory for effort to stimulate more interest in the export trade of those products.

**T**HE remarkable success that has followed export marketing efforts by the manufacturers of insecticides and of biologics convinces specialists at the Department of Commerce that nearly any chemical commodity can be sold abroad to advantage. If biologics, requiring refrigeration and careful handling, can be exported it should be easier to sell commodities that are less difficult to handle. The trade in biologics now is at the rate of \$2,000,000 a year. There has been a particularly rapid growth in the export trade in veterinary serums.

A significant feature of our export trade is that we now are exporting chemicals to Germany at the rate of \$20,000,000 annually. Our exports to France have grown also and are at a rate of about one-half of that to Germany. The export trade in pyroxylin lacquers has grown until it now exceeds \$1,000,000 annually.

## Barytes Industry of France Promises to Gain in Volume

Home Consumption Stimulates Production and Duty Restricts Competition

*From Our Paris Correspondent*

THOUGH DEPOSITS of barytes in France are considerable, home production cannot cope with the home needs and importations are necessary. The development of the French consumption goes on steadily. The Kuhlmann Works recently built a lithopone factory at Dieuze and Lyonnese manufacturers and the Air Liquide Company also take a keen interest in this material. On the other hand Marseilles' barytes industry is prosperous and growing.

The new Franco-German tariff agreement by its 25 francs tax on every ton of imported barytes enables the home product to compete favorably with foreign barytes on the home market. The home production must henceforth supply the necessary 40,000 tons required by the home needs. There is also a large demand from Belgium. The United States, Great Britain and the British Dominions high bidders and regular consumers of large quantities of barytes should find it profitable to buy French offerings.

The mining of barytes is not expensive owing to its high density, one cubic meter weighing over four tons, but its conveyance from the mining pit to the railway head often doubles the cost. The mines' prosperity depends therefore as much on the means of conveyance as on the mine's yield. Among the most favored barytes mines in that respect are the Loire and Hérault. The Haute-Loire mines can easily supply all the home needs which come mostly from Paris, Lyons and Lille while the Hérault mines can export barytes through the neighboring and now well equipped harbor of Sète.

Mining of barytes in France will undoubtedly increase owing to the growing home demand and the French mines will have to answer it by putting into practice common technical and commercial devices. Exports will also take a big increase owing to the facilities offered and French barytes which contains at least 98 per cent of sulphate of barium ought to compete most favorably with German barytes which contains only 95 per cent.

IN 1927 France's total output of tar amounted to 487,000 tons, 233,000 tons manufactured by gas works and 254,000 tons by cokeries. Saar's total output reached 116,000 tons manufactured by the Heinitz domania mines, the Arbed, Dillingen, Halbergerhütte, Neunkirchen and Roechling cokeries and in small part by gas works.

Saar exports were as follows: Germany, 22,000 tons; Belgium and Luxembourg, 9,000 tons; other countries, notably Switzerland, 13,000 tons. The Road

Survey used 10,000 tons, 3,000 tons being refined tar, and 5,000 tons of Saar tar was imported in France.

France exported 13,000 tons of tar, 10,000 tons being refined, sent to the French colonies. French consumption reached 543,000 tons, 338,000 being used by still-houses and 132,000 being used by the Roads Survey.

The Saar imports being unsufficient to complete the home needs, German tar was imported to the amount of 41,000 tons, 36,000 tons being refined. These figures giving the present general state of the world market for tar and its by-products were quoted at the last general meeting of the Comité Central des Producteurs et Distillateurs de Goudron en France. The increasing use of tar in the making and covering of roads in Great Britain and the United States has removed the disturbing elements of the tar world market which is now in a most satisfactory condition. This would not be the case if tar had to be distilled and coal-tar pitch sold for the manufacturing of briquets only. The coal-tar pitch maker has been generally firm though speculation has naturally shaken it up a bit. There is always a large demand for creosote in America. The pyridine and anthracene markets have been as dull in 1927 as in 1926, the naphthaline, phenol and cresols markets have been slightly more active, especially abroad. In 1927 the output of benzol reached 61,200 tons, 12,700 tons being manufactured by gas works and 48,500 tons by coke ovens and tar still-houses. This total output was used in the following manner: benzol 90 and 50: 24,200 tons; motor-benzol 20,000 tons; toluol 2,300 tons; solvents 6,000 tons; benzine, toluene, xylene: 3,000 tons; light oils and raw byproducts: 5,600 tons.

Saar's output was about 34,000 tons, 4,000 tons being the domania mines' contribution. Part of this output remained within the Saar territory's bounds. The Comité Central des Producteurs et Distillateurs de Goudron en France attach the greatest importance to the benzol question and has named a special committee called Union Française des Producteurs de Benzols, in brief Unibenzols, which specially studies all the technical, fiscal and legal problems concerning benzol.

THE technical press has lately given information on the new Michot-Dupont process which by working and deodorizing residues of animal and vegetable organic matter obtains special acid fats for soap manufacture. These processes are used by the Paris' society S.A.F.A.G. and the London British Tallow Corporation Ltd.

Here is a summary of the two patents taken by the inventor Mr. Michot-Dupont: Patent 553,338 of June 26, 1922, is a process for the purifying and bleaching of mineral oils, but is also applied to fats of animal and vegetable origin. The process consists in the treatment by sulphuric acid, with, when needed, the additional use of a compound capable of disengaging oxygen such as a persel for instance. The remaining mass after decanting all impurities is further treated with sulphurous acid, for instance, or one of its compounds, this operation being made at an appropriate temperature. The latter treatment, says the inventor, is not absolutely necessary when treating certain saponifiable oils easily attacked such as fish oils. Finally the residuary mass, after this operation has been made at convenient heat, is carried away by an appropriate gas or steam current, the choice of which is made according to the nature of the substance treated.

The additional patent No. 32,762 of December, 1926, published on February 28, 1928, gives accurate details on the refining of fatty acids obtained by deglycerinization of saponifiable fats by the usual hydrolysis process. The fatty acids are treated with sulphuric acid in a proportion of 1 to 7 per cent and brought into contact with a substance capable of disengaging oxygen such as persel. It is then washed, dried and carried away in a still.

ATTENTION of the French rayon manufacturers has been drawn to linseed or flax cellulosic pulp. This pulp gives rayon of most resisting and elastic qualities. This is not surprising as the pulp of a high purity contains 92 to 93 per cent of cellulose, i.e., its chemical compound is very near to the chemical composition of linters.

It is obvious that if this pulp could be obtained at a slightly higher price to wood pulp there would be an extensive demand for it. The rayon manufacturers in fact only use wood pulp because it is cheaper than linters. Linters is used only for manufacture of very fine silks of superior quality, cupra ammonium rayon for instance, but even acetate rayon is made with wood pulp of high cellulose content.

### Canada May Increase Tariff on Sodium Sulphate

BISHOPRIC & LENT CO., owners of a natural deposit of sodium sulphate located at Expanse in the Province of Saskatchewan, has entered an application for an upward revision of the Canadian tariff on sodium sulphate. Public hearings of the Tariff Advisory Board are scheduled for June 19, 1928. In their petition the company states that it has expended in plant and development work approximately \$500,000, that employment is furnished to 100 with a weekly payroll of \$2,000 and that production capacity of the plant is 50 tons daily.

## News in Brief

THE SECOND NATIONAL Fuels Meeting will be held in Cleveland, Sept. 17-20, 1928. Papers are being prepared by some of the outstanding engineers and scientists in the fuel and power fields. The Fuels Division of the American Society of Mechanical Engineers is devoting considerable time and thought to the preparation of a well-rounded and broad selection of subjects and speakers. In addition to the technical program, arrangements are being made for a number of inspection trips to the leading plants in the vicinity.

IT IS REPORTED that producers of casein in the Argentine Republic are considering the question of amalgamation with a view to increasing prices. Although this country produces 75 per cent of the world's casein output, prices have been fluctuating considerably.

REPRESENTING THE principal western district offices and experiment stations and the main office at Washington, D. C., executives of the U. S. Forest Service gathered at the Forest Products Laboratory, Madison, Wis., June 4 for their annual research conference. The purpose of this yearly conference is to consider and map out the wood utilization investigations to be conducted by the laboratory during the ensuing year. Many of these studies embrace forest management as well as problems having to do with the mechanical, physical, and chemical properties of wood.

INSTRUCTIONS DIRECTING collectors of customs to begin assessment of duty upon imports of gypsum, crushed after being quarried, have been issued by the Bureau of Customs according to an announcement June 13 by the Commissioner of Customs, E. W. Camp. It has been the practice to admit such gypsum free because of the claim that crushed gypsum was not comparable under the Tariff Act of 1922 to the material classified as ground gypsum.

H. P. CAVARLY, J. G. C. McNair and Harold Rowe have been appointed assistant managers of the Atlantic branch of the National Lead Company at New York. They will assist H. G. Sidford, manager. Mr. McNair will continue to handle the sales of the White lead in oil and Mr. Rowe the sales of dry pigments.

A. B. ANSBACHER & CO., pioneer dry color manufacturers, at New York, have sold their business, assets, land, building, machinery and good-will to the Ansbacher Color Corporation, organized recently. Bernard R. Armor, identified with a number of companies in the industry, including the G. Siegle Corporation of America, American Animal Products Company, Heyden Chemical Company, and others, is president and treasurer of the Ansbacher Color

Corporation. C. K. Weckman is secretary of the new company. The Ansbacher Insecticide Company is not involved in the sale, remaining in the hands of D. A. Ansbacher.

ARGUMENTS ON the application for higher tariff on potassium permanganate were heard by the United States Tariff Commission May 21. Hugh M. Frampton, of Washington, D. C., appeared as counsel for Carus Chemical Company, LaSalle, Ill., the applicant, while James A. Delahanty of counsel for D. H. Litter Company, Inc., New York City, argued in opposition for increased tariff duties on the product.

### Gain in Sicilian Sulphur Output Last Year

THE 1927 output of the Sicilian sulphur mines reached a total of 231,441 metric tons, as compared with 208,741 tons during the previous year. Production has declined 50 per cent since 1900, owing largely to the advent of American sulphur in world markets. Incident to the gradual improvement in the exchange value of the lira, and a slight decrease in the cost of production, a special effort to increase the output was made during 1927.

This information given in a report from A. P. Cruger, vice-consul at Messina, says that sales of sulphur in 1927 amount to 268,621 metric tons, as compared with 232,190 in 1926. From a total of 245,199 metric tons on hand December 31, 1923, stocks gradually dwindled to 94,541 tons at the end of 1926 and 59,697 at the close of 1927.

Notwithstanding slightly lower production costs, the Sicilian sulphur industry is far from being in a flourishing condition. The reasons are decreasing production, smaller stocks, and lower prices obtaining for the material.

The Minister of National Economy, in a speech before the Chamber of Deputies, on March 21, 1928, expressed his concern in regard to the critical situation of the sulphur industry, and his conviction that the new mining law would bring about needed reforms and pave the way for a solution of the crisis. In order to attract capital to this industry, a fair return on the amount invested must be assured over and above amortization charges. The industry can not be placed on a paying basis, it is said, unless the heavy burden of the "Estaglio" system of operation is removed.

Under the "Estaglio," or royalty, mode of operating the sulphur mines, the owners obtained royalties from their concessionnaires varying from 30 to 70 per cent of the total annual yield of the mines. These royalties were paid in kind. This manifestly unfair division of the profits did not tend toward increased production.

The government now intends to nationalize the sulphur deposits, placing the former mine owners in the position of concessionnaires. They will be permitted to retain only such portion of the profits as remain after the payment of interest and amortization charges.

### Expansion in Carbon Black Industry in 1927

A NEW RECORD for the production of carbon black in the United States was established in 1927, when the total output amounted to 198,429,000 lb., according to G. R. Hopkins of the United States Bureau of Mines. This represents an increase over the 1926 output of 17,863,000 lb., or 9.9 per cent. This production had a value at the plants of \$10,955,000, which represents an average value of 5.5c. per lb., the same as in 1926.

The year 1927 witnessed a material expansion in both domestic and foreign trade in carbon black. Total sales amounted to 223,430,000 lb., an increase over the previous year of 33.4 per cent. Of this amount 168,999,000 lb. was consigned to domestic consumers and 54,431,000 lb. was exported. This brisk demand had a material influence on stocks of carbon black held at plants which, for the first time since such statistics were compiled, 1922, showed a decrease by declining from 108,378,000 lb. on Dec. 31, 1926, to 82,831,000 lb. on Dec. 31, 1927.

Louisiana, or more specifically, the Monroe district of that state, easily maintained its position as the center of carbon black production, although the total production of the state declined from 130,377,000 lb. in 1926 to 124,188,000 lb. in 1927. To Texas, however, belongs the major portion of the credit for the record output of 1927, when this state produced 56,396,000 lb., an increase over 1926 of over 20,000,000 lb. Production in the two eastern states, Kentucky and West Virginia, continued to decline; production in the Rocky Mountain States of Montana and Wyoming, to increase.

The tendency toward mergers or consolidations in the carbon black industry in 1927 was much less pronounced than in 1926, the number of operators remaining at 33 and the number of plants declining from 62 to 61. The westward movement of the industry was evidenced by the growth in importance of Texas, where new plants recently erected in the Panhandle more than compensate for the dismantling of plants in West Virginia.

The channel process remained by far the most important method of manufacturing carbon black, producing 167,357,000 lb. in 1927, or 84.3 per cent of the total.

Although no recent figures are available covering the domestic distribution of carbon black as between industries, it is probable that the major portion of the 40,705,000 lb. increase in domestic sales can be credited to the rubber industry, which uses approximately half of the carbon black consumed in this country. The output of tires is estimated to have increased 5 per cent over 1926, which, combined with the fact that the modern balloon tire uses relatively more carbon black than other types of tires, is the main reason for assuming an increase in the use of carbon black by the rubber industry in 1927.

# MEN in Chemical Engineering

CLARK C. HERITAGE has been appointed senior chemical engineer in charge of pulp and paper at the Forest Products Laboratory, Madison, Wis., to succeed John D. Rue who resigned recently. Mr. Heritage was last associated with the Cornell Wood Products Company although his connection with the pulp and paper industry extends back to 1914.

JOHN P. HUBBELL, who was assistant chief of research of the New Jersey Zinc Company, has become a partner in the firm of Singmaster and Breyer, chemical engineers and metallurgists.

WALTER CROSS of Kansas City has become associated with the Babcock & Wilcox Company as consulting chemical engineer. He will now spend a part of his time in New York.

E. E. ROUTH, who has been in charge of the Southern district of the Mathieson Alkali Works with offices at Charlotte, N. C., has been transferred to the New York offices to become sales manager of the company. John W. Boyer, previously in this position, has left to become vice-president and sales manager for the Monsanto Chemical Works.

R. P. HEUER has resigned as instructor in chemical engineering at the University of Pennsylvania to become director of research for the General Refractories Company at the general offices in Philadelphia.

WILLIAM D. HARKINS, who was selected as recipient of the Willard Gibbs Medal for 1928, received the official award at the meeting of the Chicago section of the American Chemical Society on May 25. The medalist is the professor of physical chemistry at the University of Chicago, and is well known for his atomic and molecular researches.

PAUL J. KRUESI, president of the Southern Ferro Alloys Company, was elected president of the American Electrochemical Society at its annual meeting in Bridgeport recently. He will succeed S. C. Lind in his new capacity.

Mr. Kruesi was born at Menlo Park, N. J., in 1878 and after attending Union



PAUL J. KRUESI

College he held several positions in the General Electric Company. He joined the American Lava Company in 1902 and eventually became president and owner of that firm in 1918. Besides the leadership of the Southern Ferro Alloys Company at Chattanooga, he at present holds other executive posts in business activities in that district.

ARTHUR K. DOOLITTLE, formerly plant engineer in the lacquer department of the Sherwin-Williams Company at Chicago, has been promoted to take charge of all technical lacquer work for that company in the East, with headquarters at the Newark plant.

## CALENDAR OF FORTHCOMING MEETINGS

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE, convention, New York City, Dec. 27, 1928-Jan. 2, 1929.

AMERICAN CERAMIC SOCIETY, tour through France, Germany, Czechoslovakia and England, May 19-July 16.

AMERICAN ELECTROCHEMICAL SOCIETY, fall meeting, Charleston-Huntington, W. Va., Sept. 20-22.

AMERICAN ELECTRO-PLATERS' SOCIETY, sixteenth annual convention, Toronto, Ontario, Canada, June 25-28.

AMERICAN INSTITUTE OF CHEMICAL ENGINEERS, tour, with British Institution of Chemical Engineers, Quebec, Shawinigan Falls, Montreal, Ottawa, Kirkland Lake, Port Colborne, Niagara Falls, Akron, Pittsburgh, Wilmington, Edgewood, Washington, and New York, August 18-Sept. 2.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS, regional meetings, St. Paul-Minneapolis, Aug. 27-29, Boston, Oct. 1-3. Fuels Division, second national meeting, Cleveland, Sept. 17-20.

AMERICAN SOCIETY FOR TESTING MATERIALS, 31st annual meeting, Atlantic City, June 25-29.

INSTITUTE OF CHEMISTRY OF THE AMERICAN CHEMICAL SOCIETY, second session, Evanston, Ill., July 23-August 18.

INTERNATIONAL UNION OF PURE AND APPLIED CHEMISTRY, meeting, The Hague, July 18-24.

NATIONAL COLLOID SYMPOSIUM, sixth symposium, University of Toronto, Toronto, Canada, June 14-16.

WORLD CONGRESS OF ENGINEERS, Tokio, Japan, November, 1929.

ALEXANDER E. OUTERBRIDGE, JR., metallurgist for William Sellers & Company, who died on January 15, was posthumously awarded the William H. McCadden gold medal for distinguished metallurgical contributions to the industry. The award was made at the annual banquet of the American Foundrymen's Association on May 17, the medal being received by his son, Dr. George W. Outerbridge.

GERALD WENDT, who was recently appointed director of the new Battelle Memorial Institute for scientific and industrial research at Columbus, Ohio, has resigned from that position after completing the plans for the laboratory and the award of the contracts and has been appointed assistant to the president of the Pennsylvania State College, where he has for four years been dean of the School of Chemistry and Physics. He will continue as acting dean for a year but will devote himself primarily to research administration and the development of the large research program of the college.

CARSON W. SIMMS has severed his connection with the lacquer research laboratory of Commercial Solvents Corporation to enter the manufacture of lacquer. In association with G. N. Maxwell he has organized the Wabash Products Company at Terre Haute, Indiana.

D. W. WILSON has resigned from the staff of the Wilputte Coke Oven Corporation to accept the position of vice-president and general manager of Dry Quenching Equipment Corporation, a subsidiary of International Combustion Engineering Corporation, New York City. Mr. Wilson will have general charge of the technical and development work on installations of the Sulzer system for dry quenching of coke.

CHARLES MULLIN, professor of textile chemistry and dyeing at Clemson College, S. C., sailed for Europe on May 12 to spend a year studying European mills and textile schools.

In the recent International Nitrogen Conference held aboard the *Lützow* on the Adriatic early in May, America was represented by the following group: Prof. Firman E. Bear of Ohio State University; Kenneth F. Cooper, of the American Cyanamide Company of New York; Dr. Harry Curtis, of Yale University; James Edge, director of the E. I. du Pont de Nemours and Company; Sidney B. Haskell, director of the agricultural department of the Synthetic Nitrogen Products Corporation of New York; Dr. Asher Hobson, agricultural economist; Walter S. Landis, of the American Cyanamid Company of New York; William Culler Morris, president of the American Gas Association; Carl B. Peters, manager of the Synthetic Nitrogen Products Corporation; Irénée du Pont, vice-chairman of the board of directors of the E. I. du Pont de Nemours Company; C. J. Ramsburg, vice-president of Koppers Company, of Pittsburgh, and others.

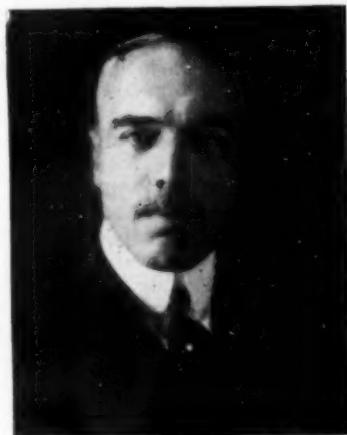
## OBITUARY

IENS PAULI LIHME, who had been consulting chemical engineer for the Grasselli Chemical Company since 1892, died of pneumonia at Lakewood, N. J., on April 1. He had just completed his eightieth year.

Dr. Lihme was a native of Denmark where, continuing a family tradition in chemistry, he received his doctorate at the University of Copenhagen. He came to the United States in 1882 and joined the Grasselli Chemical Company at Cleveland ten years later. There he became an authority on sulphuric acid and fertilizer manufacture and in addition made outstanding developments in the exploitation of waste products. He was long closely associated with C. A. Grasselli, who died last autumn.

WILLIAM HENRY NICHOLS, JR., president of the General Chemical Company, died of pneumonia at his home in Oyster Bay, L. I., on May 26. He was 54 years old and had contracted his illness only five days before succumbing to it.

Mr. Nichols was born in Brooklyn, a son of the pioneer chemical manufacturer of the same name who is at present chairman of the board of the Allied Chemical and Dye Corporation.



W. H. NICHOLS, JR.

He received his education at the Brooklyn Polytechnic Institute and the school of mines at Columbia University, and in 1894 he too entered business as a chemical manufacturer. Since that time he had become a director of the Corn Products Refining Company, Semet-Solvay Company, and Nichols Chemical Company, in addition to his presidency of the General Chemical Company.

THOMAS HENRY DAVIS, a retired chief chemist for Merck & Company, Inc., died on May 23 at his home in Newark, N. J., in his seventy-eighth year. He had already been ill for a year with a complication of diseases. Mr. Davis was a native of England and received his training at the Royal University there, but came to America in 1903. He then lived in Connecticut for seven years before finally coming to Newark.



HORACE G. CARRELL

The death of my good and dear friend, Horace G. Carrell, makes it very difficult for me to express my feelings adequately. Notwithstanding the fact that we were competitors, we were also very close personal friends. With the passing of his fine example of manhood, not only the industry, but the community as well, suffers a distinct and well-nigh irreparable loss. His broad-gaged attitude toward his fellowmen in general and his unusual faculty for understanding, together with his tolerance, combined to make him an outstanding character.

I would point especially to the great and important part he played in the organization of the U. S. Alkali Export Association, of which he might properly be called the founder and prime moving spirit. Those interested in this field of endeavor will readily testify to this splendid achievement. His place will indeed be difficult to fill.

ELI WINKLER.

HORACE G. CARRELL was born near Jamestown, N. Y., on January 12, 1873. He received his degree as a graduate of Cornell University in 1897, and soon afterward joined the Semet-Solvay Company at Syracuse. His association with the Solvay companies was to last until his death. Beginning with the development of new chemical processes, he later devoted himself to the cultivation of markets for his company's products. In 1927 he was appointed general manager of the Solvay Sales Company, the post he occupied at the time of his death. During the War he was chief of the Alkali Sections of the War Industries Board and a few years ago was instrumental in forming the United States Alkali Export Association of which he remained vice-president.

His death came quite unexpectedly from heart failure on the evening of May 17, just after he had sailed for a short vacation trip to Virginia.

\* \* \*

SANFORD B. BELDEN, vice-president of the Jeffrey Manufacturing Company, died in New York on May 15 in the course of a business trip. He had been with his firm since his graduation from Ohio State University in 1896.

PHILIP F. DU PONT died on May 17, at Wilmington, Del., following an operation for gall stones. He was 49 years old and was born in Louisville, Ky., the son of Dr. Alexis I. du Pont and the cousin of Pierre S., Irénée and Lammot du Pont. In recent years he was retired from business and had not been in good health for some time. Interest was aroused during the War years by his action in equity against twelve executives of the Powder Company, involving the purchase of a large block of stock from T. Coleman du Pont.

GUSTAV H. KOVEN, president of L. O. Koven & Bros., Inc., of Jersey City, N. J., died of an embolism on June 13 in New York. Mr. Koven, who was in his 56th year, was also president of the International Overseas Corporation, New York, and a leading industrial figure in Jersey City, where he spent most of his life.

## INDUSTRIAL NOTES

THE J. P. DEVINE MANUFACTURING COMPANY, Buffalo, N. Y., the new corporate name of the former J. P. Devine Company, has transferred a substantial interest in its business to the Mt. Vernon Car Manufacturing Company, Mt. Vernon, Ill., in order to increase the potential scope of its services to the process industries. The officers are: W. C. Arthur, chairman; J. P. Devine, president; H. H. Cust and C. P. Devine, vice-presidents; C. W. Reynolds, secretary; D. P. Settemire, treasurer; Graham Devine, plant manager.

THE LINDE AIR PRODUCTS COMPANY has opened a district sales office at 48 West McLemore Avenue, Memphis, Tenn.

THE NATIONAL ALUMINATE CORPORATION, with offices at 6216 West 66th Place, Chicago, announces the purchase of the assets of the Chicago Chemical Company and the Aluminate Sales Corporation.

THE EMERY INDUSTRIES, INC., is the new name, adopted on its 88th birthday, by the Emery Candle Company, producer of fatty acids and glycerine.

THE FOOTE BROS. GEAR & MACHINE COMPANY has appointed Woodbury and Wheeler, Portland, Ore., and the Cunningham Electric Company, Tacoma, Wash., as representatives in those territories.

THE ELLIOTT COMPANY, Jeanette and Pittsburgh, Pa., has opened new district offices at the Mining Exchange Building, Denver, Colo., and at San Francisco, Calif., with M. C. Sickels and F. A. Calmus in charge, respectively.

THE CHROMILITE CORPORATION has been established at Indianapolis for service in the line of protective metallic coating for industrial installations.

THE WAGNER ELECTRIC CORPORATION has placed E. D. Pike in charge of the San Francisco sales office.

THE KENNEDY VALVE MANUFACTURING COMPANY, Elmira, N. Y., has elected the following officers: Matthew E. Kennedy, president and treasurer; J. Carroll Kennedy, vice-president and secretary; Clarence H. Kennedy, vice-president and general sales manager.

THE H. K. PORTER COMPANY has moved its Chicago office to the New Engineering Building, Wells St. and Wacker Drive.

THE J. T. BAKER CHEMICAL COMPANY, Phillipsburg, N. J., has purchased the Dissaway Chemical Company of Brooklyn, N. Y., the operations of which are being transferred to Phillipsburg.

THE C. O. BARTLETT & SNOW COMPANY, Cleveland, has appointed J. R. Allison district manager at the Pittsburgh office.

THE BUFFALO FOUNDRY & MACHINE COMPANY has appointed O. S. Sleeper in charge of special development work and has opened a San Francisco office under C. O. Lovett.

THE H. G. TROUT COMPANY of Buffalo, manufacturers of chemical engineering equipment, has expanded its engineering and sales staff in order to give special attention to the process industries. D. S. Secord of Toronto has joined the company as vice-president and general manager.

# MARKET CONDITIONS and PRICE TRENDS

## Lithopone Attains High Place Among Chemical Pigments

Steadily increasing consuming outlets has made possible a more than three-fold enlargement in domestic production of lithopone since prewar years.

**R**EPORTING on domestic production of lead and zinc pigments in 1927, the Bureau of Mines has issued figures which call attention to the rapid growth which has attended production and consumption of lithopone.

Consumption of lithopone in this country was not of large proportions prior to 1910. In that year home producers turned out 12,665 short tons and as imports were only slightly in excess of 1,000 tons, it is evident that total consumption fell somewhat short of 14,000 tons. From that time both domestic production and consumption have shown annual expansion with the exception of 1921 and 1922 when the general depression then experienced brought a temporary check to operations. The upward movement began again in 1923 and continued uninterruptedly through 1927.

**A**CCORDING to the report recently issued by the Bureau of Mines an outstanding feature of the lead pigment industry in 1927 was the decrease of 12 per cent in the value of lead pigments sold in the United States in the face of an increase of 6 per cent in quantity of the most important pigment, white lead ground in oil, and increases and decreases in quantities in the other pigments which account for only a slight decrease on the whole. This is explained by the large decreases in average values, ranging from \$23 a ton for blue sublimed lead and white lead, dry and in oil, to \$38 a ton for litharge.

The average values of zinc pigments and salts sold in 1927 showed very much smaller decreases, ranging from \$2 a ton for zinc chloride to \$7 a ton for zinc oxide and leaded zinc oxide. There were increases in sales of all the zinc pigments and salts with the exception of zinc chloride which showed a decrease of 21 per cent. Sales of lithopone increased 11 per cent and of zinc sulphate, 145 per cent.

A statistical presentation of domestic

production of lead and zinc pigments for the last seven years will be found in the accompanying table with the totals for 1914 included to furnish a comparison with the prewar standards.

production was more than 82 per cent higher than that reported for 1914. The figures, as given, for zinc oxide production do not include the output of leaded grades, of which 26,064 tons was produced in 1927. Exports of zinc oxide increased during war years and in 1927 were practically on war-time levels, amounting to 16,362 tons.

Through the co-operation of pro-

Domestic Production of White Lead, Lead Oxide, Zinc Oxide and Lithopone

	( <sup>1</sup> ) White Lead Tons	Zinc Oxide Tons	Lithopone Tons	Red Lead, Tons	Litharge Tons	Leaded Zinc Oxide, Tons	Orange Mineral, Tons
1914.....	159,474	82,809	32,819	18,697	27,345	11,317	426
1920.....	145,695	99,444	89,373	34,431	62,329	30,460	( <sup>2</sup> )
1921.....	170,283	74,329	55,016	21,805	41,909	16,103	381
1922.....	194,991	128,465	83,360	30,509	58,261	19,613	370
1923.....	162,873	126,987	98,199	38,037	75,107	23,504	646
1924.....	187,494	131,470	109,469	36,813	74,724	26,729	331
1925.....	163,905	153,940	145,019	41,669	86,546	31,750	840
1926.....	149,813	146,923	159,931	42,550	82,540	23,859	813
1927.....	157,695	151,246	176,994	39,073	81,655	26,064	709

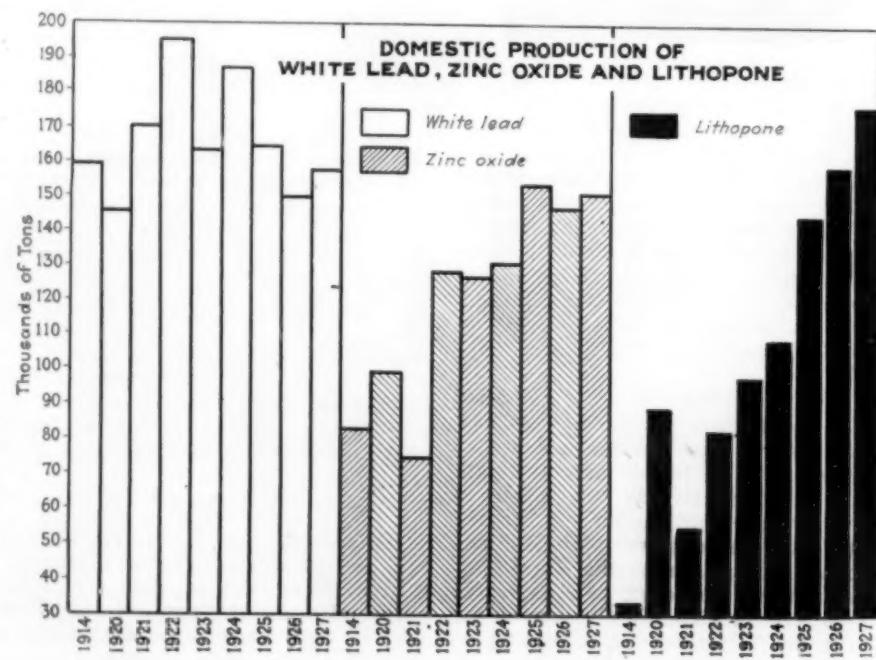
(<sup>1</sup>) Does not include sublimed white lead. (<sup>2</sup>) Included in total for red lead.

**T**HESE figures indicate that expansion in the white lead industry has not been in keeping with the growth in the paint trade which is the largest consumer of the pigment. Export shipments of white lead also have declined in volume. In 1920 exports of white lead amounted to 17,204 tons, whereas outward shipments in 1927 reached a total of only 6,047 tons. The United Kingdom accounted for more than one-half the total exports with the Netherlands and Argentina each taking nearly 10 per cent.

Zinc oxide, in recent years, has been benefitted by enlarged operations in the paint and rubber industries and 1927

ducers of lithopone, the Bureau of Mines was able to show distribution by industries and in 1927 sales of 176,994 tons of lithopone were allocated as follows: for paint, varnish, and lacquers, 131,145 tons; for floor coverings and textiles, 31,186 tons; for rubber, 7,653 tons; for miscellaneous uses, 7,010 tons.

In its early stages of manufacture, difficulty was found in producing lithopone which would retain its color when exposed to the rays of the sun. With this difficulty overcome, lithopone not only found a widening market at home but entered into export trade and in 1927 shipments to foreign countries amounted to 2,110 tons.



## MARKET APPRAISAL OF CHEMICAL INDUSTRY

### Chemical Stocks Sell Off in Declining Market

**I**N COMMON with the decline which was almost general in the stock market during last month, stocks and securities of chemical and associated companies displayed a declining tendency. The downward trend in the market was attributed partly to a natural reaction following a prolonged upward swing, partly by sales representing profit taking, and to some extent by belief that the political and industrial situation might adversely affect profits from manufacturing operations.

Among the important developments of the month was the offer of the newly-formed Gold Dust American Corporation to absorb the Gold Dust Corporation and the American Linseed Company. Under the terms offered Gold Dust stockholders would receive two shares of the new corporation for each share now held and stockholders of American Linseed would receive two and two-tenths shares for each share now held. This was not acceptable to the latter but negotiations are still in progress.

**T**HE trend toward mergers likewise was shown in the announcement that the International Printing Ink Corporation had acquired the business and assets of The Ault & Wiborg Co. of New York, The Ault & Wiborg Co. of Ohio, The Queen City Printing Ink Company, and Philip Ruxton, Inc.

A meeting of stock holders of the Grasselli Chemical Company has been called for June 27 to vote on splitting the \$100 par common stock at three new no par shares for one old and to authorize new common shares for future financing. The company will take steps to list the preferred and the new common on the New York Stock Exchange.

Freeport Texas Co. has declared the usual extra dividend of 75c. and regular quarterly dividend of \$1, payable to Aug. 1 to stock of record July 14. Production of sulphur by this company for the first five months of this year was 356,890 tons as against 303,225 tons for the corresponding period of 1927. Total production in May was 83,580 tons, the largest for any single month in the history of the company.

International Paper Co. has acquired the Southern Paper Co. owning and operating a modern pulp and kraft paper mill of 100 tons daily capacity at Moss Point, Miss. The company also has taken over a newsprint mill of 170 tons daily capacity at Pyrites, N. Y.

Reports that the Newsprint Export Association of Canada has been dissolved have caused a break in stock prices of Canadian paper companies. It is regarded that this will open up competitive selling which will result in lowering values.

Price Range Since Jan. 1		Sales May	Stock	May 11	Price Range for Month		
High	Low				High	Low	June 9
31½	22½	8,600	Acetol Products	25	25	22½	23½
197½	120	30,100	Aluminum Co.	197½	197½	165	165
74	60½	123,400	Air Reduction	74	74	66	66½
148	8½	81,140	Ajax Rubber Co.	9½	10	8½	8½
173½	146	186,100	Allied Chemical	166½	173½	160	169
127½	122	4,210	Allied Chemical pf	123½	127½	122	122½
16½	11½	14,700	Amalgamated Leather	14½	14½	11½	11½
23½	15½	51,800	Am. Ag. Chemical	19½	23½	18½	19½
75	55½	44,600	Am. Ag. Chemical pf	67½	75	64½	67
53½	38½	44,000	American Cyanamid B	53½	53½	44	44½
15½	10½	1,600	Am. Hide & Leather	14	14	10½	10½
113½	56½	209,100	American Linseed	97½	113½	97	105½
117½	56	9,400	American Linseed pf	108½	117½	109½	115
49½	39	75,100	American Metals	47½	51	47	47
24	13	47,800	Am. Rayon Products	13	23½	13	22
28½	11½	52,700	Am. Solvents & Chem	28½	28½	20½	20½
54	26½	35,700	Anglo-Chile Nitrate	51	51	31	43
97	54	95,200	Archer-Daniels-Midland	92½	95	74½	83
32½	31	10,300	Ass. Dyeing & Printing	32½	32½	31	31
101	63	2,600	Atlas Powder	82	83	79	79
52½	25½	13,600	Barnet Leather	35	35	28½	31½
20½	12½	115,200	Beacon Oil	17½	17½	14½	14½
83½	71	11,300	Beech-Nut Packing	79	80½	76	76½
78½	65½	35,000	Bon Ami A	70	78	68	71
74½	65	34,400	Bristol-Myers	73	74½	69	69
32½	24	...	Calif. Petroleum	32½	32½	29½	29½
103	70½	30,600	Celanese Corp	103	103	75	75
185½	150	7,650	Celanese Corp. 1 pf	158½	169½	150	150
64½	40½	225,900	Certainteed pr	56½	58½	40½	47½
52½	47½	8,400	Chickasha Cot. Oil	51	52½	47½	47½
189½	153½	14,800	Commercial Solvents B	170½	170	163	163
82½	64½	105,600	Corn Products	80	81½	71½	71½
146½	138½	1,900	Corn Products pf	145½	146½	144½	144½
57½	34½	169,400	Davison Chemical	51	57½	45½	45½
61	40	10,300	Devoe & Reynolds	55	55½	50	51
120	108	500	Duoz Corporation A	115	120	114½	117
9	4½	5,800	Du Pont	5½	9	4	8
405½	310	31,800	Du Pont 6 pc. db.	393½	405½	380	382½
121½	115	6,300	Eastman Kodak	120½	121½	118	118½
186	163	54,700	Firestone Tire	182½	186	177½	177½
238	166	2,525	Fisk Rubber	175½	175½	170	170
17½	14	91,400	Fleischmann	73½	75½	68½	68½
76½	66	175,700	Freeport Texas	73½	74½	63½	70
109½	63½	245,300	Glidden	23½	26½	23½	24
26½	20½	95,700	Glidden pf	100½	104½	100½	100½
104½	95	3,270	Gold Dust	92½	102	88½	90½
105½	71	144,900	Goodrich Tire	90½	90½	76	76
99½	76	101,800	Houston Oil	148½	157	137½	137½
167	127	64,500	Humble Oil	84½	84½	76½	76½
84½	59½	137,200	Industrial Rayon A	23½	23½	20½	20½
26	17½	77,400	Intern. Ag. Chemical	16½	20½	16	18½
20½	13	75,900	Intern. Ag. Chemical pf	69	79	69	76½
79½	48½	12,300	International Paper	83½	86½	73½	73½
86½	67½	309,700	International Salt	68	68	52½	59½
69	49½	4,730	Kelly-Springfield Tire	21½	22½	18½	19
27½	15	57,100	Lee Rubber & Tire	21½	22½	19	19½
24½	17½	128,900	Lehn & Fink	51½	51½	46	46
53	38	48,900	Libby-Owens	139½	139½	129	130½
139½	109	2,570	Liquid Carbonic	73½	76½	67½	69½
77½	63½	70,000	Mathieson Alkali	127½	132	125	127
137½	119	23,000	Mathieson Alkali pf	127½	125	120	120
130	115	110	Monsanto Chemical	...	...	...	...
58½	35½	28,200	Natl. Dist. Products	42½	45	36	36½
136	123	3,700	National Lead	130	133½	124	124
147½	139	1,300	National Lead pf. A	147	147	146	146
260	180½	1,860	New Jersey Zinc	232	232	217	217
68½	58½	30,200	Ohio Oil	68½	68½	61	62
95½	74½	7,200	Owens Bottle	87½	89½	82½	83½
101½	85	10,700	Palmolive-Peet	101½	101½	96½	100
44½	35½	118,400	Phillips Petroleum	42	42	38	38
234	210	...	Pittsburgh Pl. Glass	226	226	222	223
61½	51½	10,600	Pratt & Lambert	59½	59½	55½	55½
300	247	...	Procter & Gamble	24½	24½	22½	22½
27½	19	65,700	Pure Oil	...	...	...	...
76½	65½	...	Sherwin-Williams	...	...	...	...
29	17	22,000	Silicon Gel	...	...	...	...
30½	17½	692,200	Sinclair Oil	29½	29½	22½	22½
34	25	76,500	Skelly Oil	32½	33	28½	28½
63½	53	124,400	Standard Oil Cal.	61½	62½	56½	56½
49	37½	832,300	Standard Oil N. J.	45½	46	42½	42½
41½	28½	1,142,600	Standard Oil N. Y.	38½	39½	33½	33½
7½	2½	20,800	Standard P. Glass	5½	5½	4	4
49	31½	27,200	Sun Oil	48	48½	43	43
23½	16	650	Swat & Finch	23½	23½	17½	22
16½	10½	162,400	Tenn. Copper & Chem	14	16½	13½	14½
66½	50	697,600	Texas Company	63½	66½	58½	58½
80½	67	370,000	Texas Gulf Sulphur	72½	72½	67	67
27½	19½	114,700	Tidewater Oil	26½	27½	24	24
630	450	2,410	Tubize Silk	59½	59½	53½	55½
162½	136½	139,400	Union Carbide	157½	157½	147½	147½
57	42½	48,900	Union Oil Calif.	53½	53½	48½	50
95	52½	9,900	United Piece Dye Wks	89	89	81½	81½
122½	102½	73,100	U. S. Ind. Alcohol	118½	119½	105½	105½
122½	119	700	U. S. Ind. Alcohol pf.	122	123½	...	...
51	22	116,400	U. S. Leather	49½	49½	41	41
63½	38½	116,400	U. S. Rubber	42½	46½	38½	38½
87½	75	160,700	Vacuum Oil	82	82½	77	77
96	60	132,100	Vanadium Corp.	86	88½	78	80½
74	58	28,000	Vick Chemical	73½	74	68	69
16½	13½	32,100	Va.-Ca. Chemical	14½	16½	14½	14½
53	44½	19,500	Va.-Ca. Chemical pf.	48	53	48	50½
85½	67	46,200	Wesson Oil	85½	85½	78½	78½
16	11½	24,100	Wilson & Co.	15½	15½	14½	14½

# ECONOMIC INFLUENCES

## *on production and consumption of CHEMICALS*

### Manufacturers Curtail Output of Chemical Products

Recession in Consuming Demand Has Influence on Productive Activities

ACCORDING to indexes of employment compiled by the Bureau of Labor, production of chemicals in April was three-tenths of one per cent lower than in March and one and seven-tenths per cent under that for April, 1927. Private reports indicate that further curtailment of productive activities was made in May. On the authority of employment indexes, operations within industries which are consumers of chemicals have receded more than manufacture of chemicals. This has given confidence in the accuracy of reports which stated that stocks of chemicals were increasing at producing points. With few exceptions, however, surplus stocks have not been important as market factors. It is conceded that seasonal conditions have brought some curtailment of manufacturing operations but the movement of chemicals for the year to date has been along generous lines.

industry report that it is conservatively estimated demand for window glass during May exceeded the output by close to 150,000 boxes, and on the basis of present production schedules all signs point to further material reduction in manufacturers' stocks this month and next. However, some of the larger orders placed by jobbers last month were in consequence of the increase in selling prices May 11.

The rayon market is rather featureless because the industry is in its customary seasonal lull pending the resumption of fall manufacturing. Rayon yarn consumption last year was in the neighborhood of 100,000,000 pounds, of which 75 per cent was the year's domestic output, 10 per cent the carryover from 1926, and 15 per cent comprising imports. The domestic output this year will not greatly exceed the distribution and sale of domestic rayon last year,

volumes this year despite losses in the sulphuric acid trade. Calcium compounds also show increases in quantities and wood distillation chemicals including methanol, acetate of lime, and formaldehyde have gained headway in export trade. Copper sulphate exports through April were materially above those for the first four months of last year and this advantage was further increased if private reports of May exports are to be credited.

Foreign consignments of potassium compounds in April were unusually heavy amounting to 7,317,058 lb. as compared with 258,127 lb. in April last year. For the four months periods exports were 11,479,559 lb. and 875,759 lb. respectively.

Totals for exports of sodium compounds were larger in April and in the four-month period but this was due largely to gains in shipments of sodium borate. Caustic soda exports gained in April but showed considerable loss for the four months.

Imports of chemicals in April were valued at \$12,394,040 which compares with \$11,384,230 in April last year. For the four-month period ended April, arrivals of sal ammoniac were almost cut in two and the downward trend is still in evidence. Potassium compounds as a whole show very little quantity changes for the four months but sodium salts were imported in smaller amounts. In the fertilizer group imports of nitrate of soda, sulphate of ammonia, and potash are far ahead of those for the corresponding period of last year.

### Thirteen Concerns Absorbed By Montecatini

TRADE commissioner E. Humes, at Rome, reports that the Italian chemical industry is passing through a period of concentration. The dominant factor in the Italian chemical industry, the Societa Montecatini, in line with the consolidation and centralization program fostered by the Government, recently announced the absorption of 13 companies without increase of capitalization. The Societa Montecatini is capitalized at 500,000,000 lire and its scope of operations is extensive. It owns and controls copper and iron pyrite mines, lead, zinc, sulphur and lignite mines; marble quarries and hydro-electric power plants and produces an extensive range of industrial chemicals and fertilizer materials. The organization recently entered the field of explosives and nitrocellulose lacquers and future development plans contemplate the manufacture of alumina and aluminum on a large scale.

Operations in Specified Chemical and Chemical-Consuming Industries, March-April, 1927-1928

	1928		1927	
	March	April	March	April
Production				
Acetate of lime, 1,000 lb.	13,022	11,743	14,223	13,138
Methanol, crude, gal.	657,460	610,253	726,694	666,638
Methanol, ref., gal.	442,023	468,446	567,059	420,741
Chemical wood pulp, ton	228,692	211,162	235,408	218,996
Automobiles—cars, number	371,821	364,877	345,911	357,009
—trucks, number	41,558	45,071	48,532	47,750
Byproduct coke, 1,000 tons	4,065	3,925	3,880	3,708
Plate glass, 1,000 sq ft	11,297	9,953	11,641	10,299
Glass container, gross	2,570	2,421	2,234	2,205
Oleomargarine, 1,000 lb.	27,288	24,291	25,484	23,569
Cottonseed oil, crude, 1,000 lb.	108,387	56,945	186,914	106,887
Petroleum refining (run to stills), 1,000 bbl.	72,124	72,979	68,741	66,624
Consumption				
Wool in textile mills, grease equivalent, 1,000 lb.	46,757	38,855	54,262	43,971
Cotton in textile mills, bales	581,318	525,158	693,081	618,279
Silk, in textile mills, bales	52,011	41,258	49,242	47,853

Activities within some branches of the chemical industry and in specified consuming industries for March and April with comparisons for the preceding year, will be found in the accompanying table.

Production of tires, balloon and cord, in April is reported at 4,633,308 as against 4,724,748 for April, 1927.

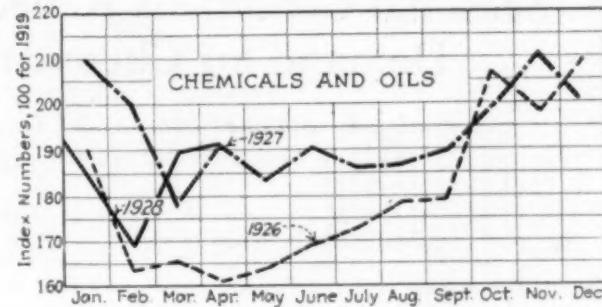
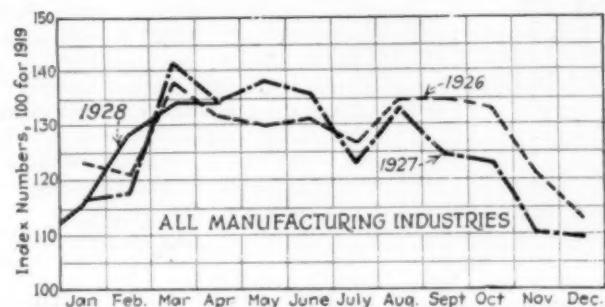
INCREASES in stocks of sole leather were reported at the end of April but sole leather stocks in process of tanning at that time were 5,072,954 pieces as compared with 4,931,695 pieces at the end of March. Tanners then were estimated to be operating at from 70 to 75 per cent of capacity which represented considerable advance over the corresponding period of 1927.

Demand for window glass has been generally satisfactory. Factors in that

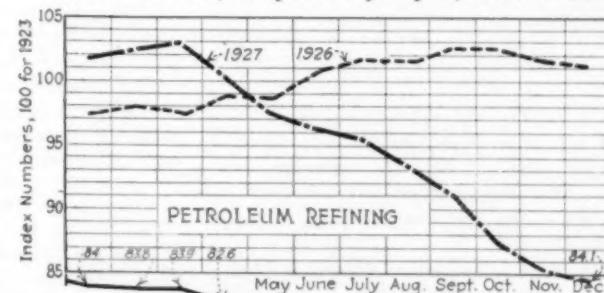
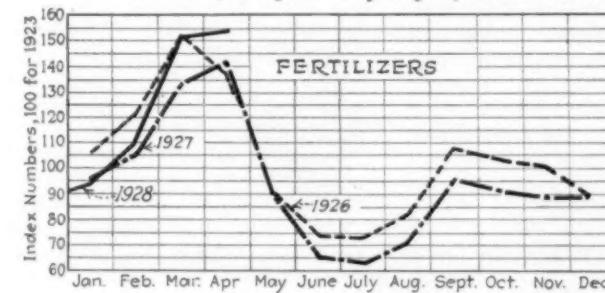
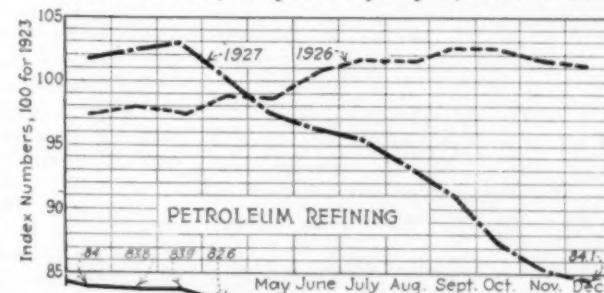
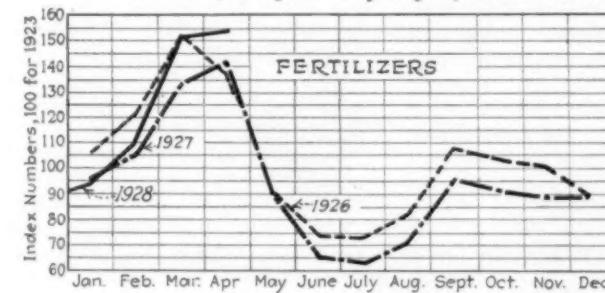
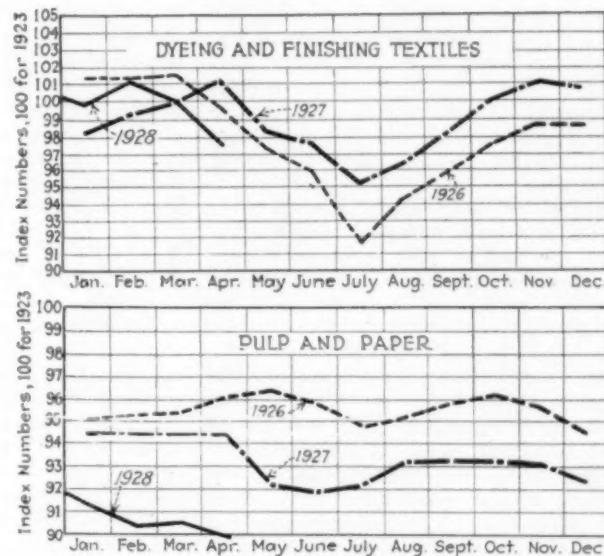
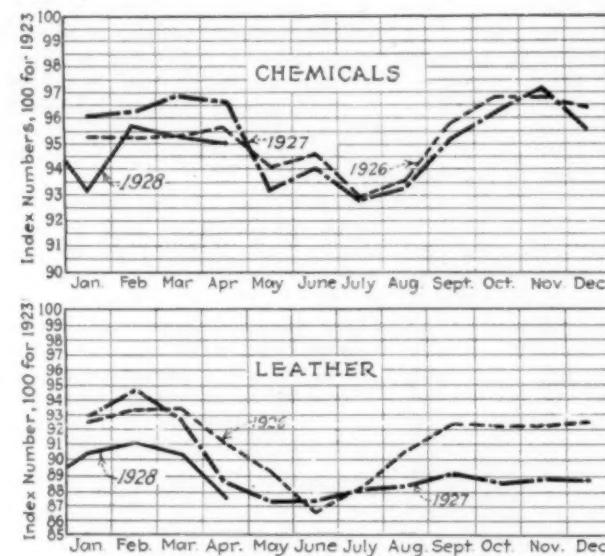
while imports are likely to drop behind those of a year ago as domestic supply more evenly balances demand.

EXPORTS of chemicals in April had an invoice value of \$10,393,293 as compared with \$12,307,933 for April, 1927. Comparison on a purely monetary basis, however, is hardly equitable as differences in unit values would be reflected in the quantity figures. This is noted particularly in the case of outward shipments of coal-tar products where export values for April were \$932,006 as against \$2,097,534 for April, 1927, whereas exports of coal-tar crude distillates were far larger in April than in the corresponding period of last year. Shipments of benzol, however, were sharply lower in April of this year. Shipments abroad of acids and anhydrides have been running to larger

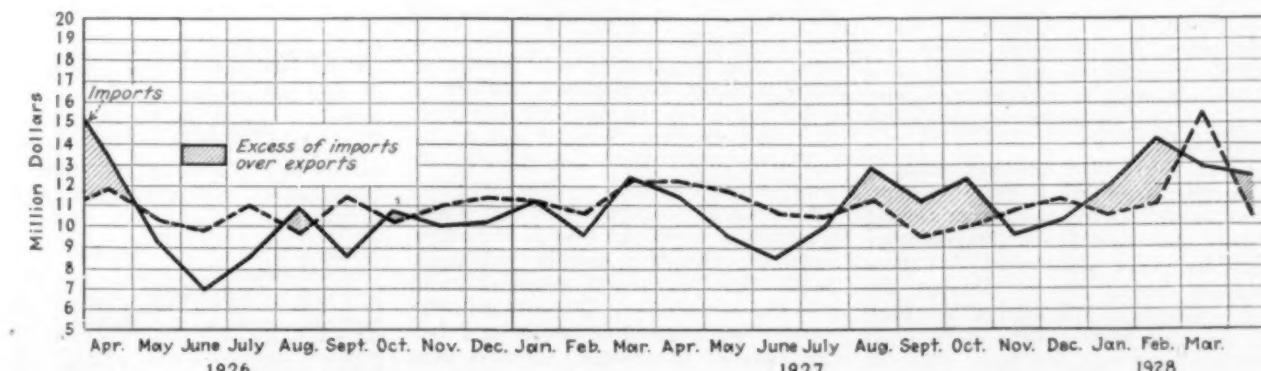
# INDEXES OF ACTIVITY IN PRODUCING AND CONSUMING INDUSTRIES



VOLUME OF PRODUCTION (U. S. Dept. of Commerce)



FACTORY EMPLOYMENT (U. S. Dept. of Labor)



FOREIGN TRADE IN CHEMICALS AND ALLIED PRODUCTS

## MARKET CONDITIONS and PRICE TRENDS

### Seasonal Conditions Reflected in Demand for Chemicals

#### Approach of Summer Season and Inventory Periods Tends to Curtail Buying

**W**HILE many chemicals are passing into consumption in a large way, the market as a whole has slowed up in the last month and new orders have been coming to hand in diminishing volume. This noted particularly in the case of fertilizer chemicals. The active mixing season has been succeeded by a period of dullness. In consequence call for spot supplies of sulphate of ammonia has been quiet and prices have reacted from the high level recently maintained. Animal ammoniates, potash salts, sulphuric acid, and phosphate rock have shared in the slower buying movement.

Nitrate of soda which had been in limited supply in domestic markets followed the lead of other fertilizer chemicals and the slowing up in demand both here and in Europe brought about an easier price tone.

A report to the Department of Commerce states that announcement was made on May 24, that the Chilean Government has agreed to grant a bonus on Chilean nitrate equal to any price reduction which may be effected by the German nitrate syndicate. This bonus will affect nitrates on consignment, in the hands of sellers, or in transit up to the end of June after which time it will be given to producers on sales made during the year ending June 30, 1929.

**G**LYCERINE, which has been in a weak position for several months, is still unsettled with an uncertain outlook. Buying interest on the part of powder makers has failed to come up to expectations. At this time last year selling had made considerable progress on anti-freeze account but this has not been the case this year and while it is too early to deduce that present lack of buying foretells any falling off in consumption in that direction, the feeling of uncertainty is heightened. Basic conditions in the glycerine market are summed up by saying that foreign markets are depressed and domestic production is running in excess of consuming requirements.

One of the most prominent features in the present market is the keen competition which exists among producers of borax and boric acid. Drastic price reductions were announced in these chemicals during the month but the price structure of the market has been weak for some time and the open cut in quotations was scarcely more than an adjustment of quotations to actual sales levels. It is reported that improved

processes in manufacture have reduced production costs to a point commensurate with current sales prices but it is also rumored that lower prices have resulted from attempts of producers to widen consuming demands so that they will absorb the increase in production. Incidentally, there has been a very active export demand for borax and shipments for the first four months of this year totaled 52,776,649 lb. as compared with 15,491,167 lb. for the corresponding period of last year. The average value of 1928 exports was slightly in excess of 2.7c. per lb. as compared with 3.7c. per lb. in the first four months of 1927.

**I**NTEREST has been shown by importers and by producers of sulphate of quinine in a report from Holland which indicated that a settlement of the suit of the Department of Justice against the Kina Bureau had been reached. It was stated, though not yet confirmed, that one condition of the settlement is that American producers of sulphate of quinine are not to be prevented by unfair means from securing bark.

Latest reports on disappearance of cottonseed oil show a decline in consumption and large unsold holdings of fats indicate that the market is suffering from overproduction. Linseed oil has been fairly strong with the trade marking time pending the first report on flax acreage.

#### Marketing Organization for Naval Stores

**R**EPRESENTATIVES of naval stores operators of five Southern States met at Jacksonville, Fla., on June 11 to perfect the organization of the Naval Stores Marketing Corporation. The corporation was formed to stabilize naval stores prices and secure a fair profit for the member operators. It is the first step toward unanimous action by naval stores operators of the South toward marketing their products.

Officials of the corporation stated that approximately 90 per cent of the operators of Florida, Georgia, Alabama, South Carolina and Louisiana would join the corporation. Operation of the concern is expected to begin in a few days, when it is believed that more than \$300,000 of the capital stock will have been paid in.

The effect on the market was seen in a prompt advance in quotations for turpentine and rosin. New crop offerings, however, are moving in good volume to distribution points and radical price changes are not regarded as probable. Nevertheless it is believed that the newly formed organization will have a stabilizing effect on values throughout the year.

#### Larger Output of Aluminum Salts in 1927

**T**HE production of aluminum salts in the United States in 1927 was 378,770 short tons, valued at \$14,288,430, an increase of \$1,086,420 or 8 per cent in value and 5,075 tons or 1 per cent in quantity, as compared with 1926, according to a statement prepared by J. M. Hill, of the United States Bureau of Mines.

The makers of aluminum salts consumed 79,130 long tons of domestic bauxite and 58,740 tons of imported bauxite, a total of 137,870 tons, valued at \$1,857,590 at consuming works. There were also consumed 720 tons of alumina and 2,780 tons of aluminum hydrate in the manufacture of the salts.

Exports of aluminum sulphate from the United States in 1927 were 21,129 short tons, valued at \$491,968.

Production of Aluminum Salts in the United States In 1927			
	No. of Producers	Short Tons	Value
<b>Salt</b>			
<b>Alum:</b>			
Ammonia.....	5	5,200	\$319,820
Soda.....	3	14,230	928,870
<b>Aluminum chloride:</b>			
Liquid.....	4	2,760	139,830
Crystal.....	3	270	36,130
Anhydrous.....	3	14,100	3,878,120
<b>Aluminum sulphate:</b>			
Commercial—			
General.....	14	309,400	7,708,450
Municipal.....	5	6,810	149,540
Iron-free.....	8	20,210	706,910
Other aluminum salts*	6	5,790	420,760
		<b>378,770</b>	<b>\$14,288,430</b>

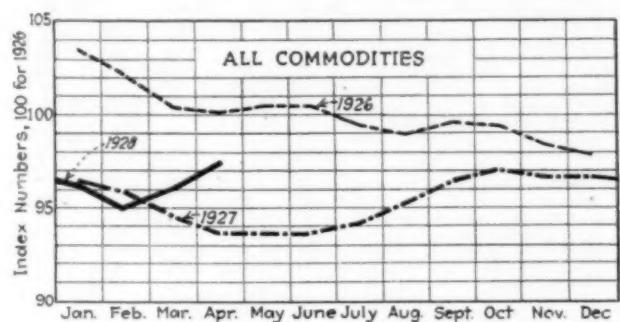
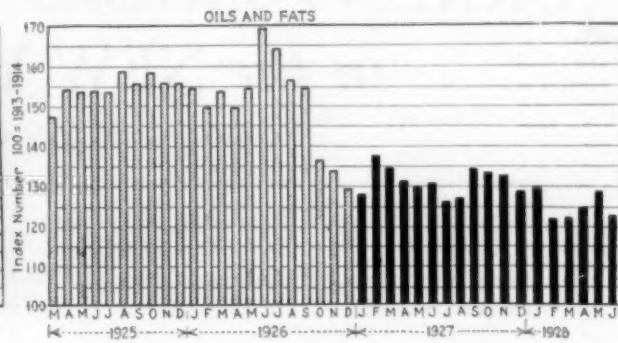
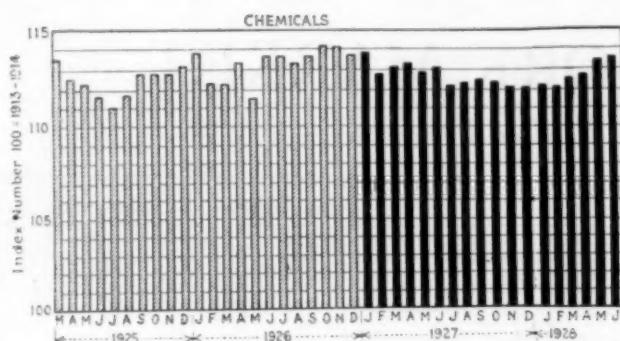
\* Two producers each of potash alum, alumina, and sodium aluminate.

#### Large Output of Coal-Tar Crudes in 1927

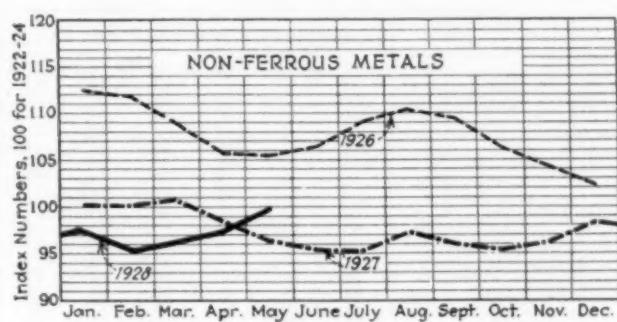
**S**TATISTICS showing the quantity and value of the domestic production of coal-tar crudes in 1927 have been issued by the U. S. Tariff Commission. The figures refer to production by companies not primarily engaged in the operation of coke-oven plants and are as follows:

Name	Quantity	Value
Total all crudes.....	227,776,355	
Carbolite oil or middle oil, gal.	260,690	37,357
Dead or creosote oil, gal.	76,395,325	9,847,932
Naphthalene crude, lb.	45,298,441	470,806
Other distillates, gal.	5,263,199	809,130
Pitch of tar, tons.....	457,073	7,794,642
Refined tars, bbl.....	1,377,703	6,172,825
Solvent naphtha, gal.....	820,701	118,205
Tar distilled, gal.....	244,550,564	

## CHEM. & MET. Weighted Indexes of PRICES



U. S. Dep't of Labor



Engineering &amp; Mining Journal

## Lower Production Costs and Larger Stocks Depress Chemical Values

**A**MONG important price changes in the market for chemicals during the past month was a drastic decline in quotations for borax and boric acid. Improved processes by which production costs have been lowered is given as the reason underlying the price change. Freer offerings of nitrate of soda and sulphate of ammonia brought about a reduction in quotations for those chemicals. Selling pressure also was noted in some of the soda salts and the easier tone was attributed to accumulations in seller's hands. Tin salts followed a downward course in sympathy with the metal.

On the other hand the regular advance in price for denatured alcohol became effective on June deliveries. Copper sulphate was distinctly higher and

other copper salts were firmly held. The lead oxides moved into higher ground because of a stronger metal market. The weighted index number, however, was slightly lower for the period and the influence of large holdings is expected to become more prominent as a market factor in the next two months.

Reports that operations have been continued at a mine in Nevada combined with larger importations of pyrites has caused some discussion regarding the stability of prices for sulphur. The present capacity of the Nevada plant, however, is given as 40 tons per day and the fact that sulphuric acid manufacture has been progressing and that exports of sulphur are running ahead of those for the corresponding period of 1927 would not indicate that quotations for sulphur would undergo any reduction.

Demand for nitrate of soda for European delivery has been quiet for some weeks and a slowing up in interest on the part of domestic buyers resulted in a downward price movement, the permanence of which will depend largely on the future buying movement. Call for sulphate of ammonia also eased off and reduced prices were due to a let-up in buying.

Cream of tartar and tartaric acid are maintaining a firm position, but the future level of prices will hinge to a large extent on the action taken by the Tariff Commission on the request for an

increase in the import duty. Just at present foreign markets are strong, but under any conditions foreign competition would be lessened should a 50 per cent increase in duty become operative.

**D**ECLINEDLY lower price levels have been reached by vegetable oils and fats during the month. For the most part this condition was due to the unusually large stocks of lard and the consequent decline in prices for that commodity. Demand for lard compound has dwindled and smaller sales of cottonseed oil not only have weakened prices for that oil, but also for competing materials. The lard situation is beyond any immediate improvement, but crop conditions in the cotton-growing states will exert an influence in the near future with lower prices probable before any upward swing to values will be met. Crop conditions also will have a bearing on prices for linseed oil.

### Chem. & Met. Weighted Index of Chemical Prices

Base = 100 for 1913-14

This month	113.06
Last month	113.20
June, 1927	112.83
June, 1926	113.67

The weighted index number was lowered due to the influence of easier markets for sulphate of ammonia and borax. Higher prices ruled for several chemicals including copper sulphate and denatured alcohol. The majority of heavy chemicals held an unchanged course.

### Chem. & Met. Weighted Index of Prices for Oils and Fats

Base = 100 for 1913-14

This month	122.76
Last month	128.38
June, 1927	130.07
June, 1926	169.79

Following the lead of cottonseed oil an easy tone permeated the market for oils and fats. Accumulations of lard are heavy and this creates a bearish situation on other oils and fats. Weather conditions will have an important bearing on future values for cottonseed oil.

# CURRENT PRICES in the NEW YORK MARKET

*For Chemicals, Oils and Allied Products*

The following prices refer to round lots in the New York Market. Where it is the trade custom to sell f.o.b. works, quotations are given on that basis and are so designated. Prices are corrected to June 16.

## Industrial Chemicals

	Current Price	Last Month	Last Year	Current Price	Last Month	Last Year	
Acetone, drums.....lb.	\$0.13 - \$0.14	\$0.13 - \$0.14	\$0.12 - \$0.13	Orange mineral, cask.....lb.	\$0.112 - .	\$0.112 - .	\$0.124 - .
Acid, acetic, 28%, bbl.....ewt.	3.38 - 3.63	3.38 - 3.63	3.38 - 3.63	Phosphorus, red, cases.....lb.	.62 - .65	.62 - .65	.62 - .65
Boric, bbl.....lb.	.064 - .07	.064 - .084	.064 - .084	Yellow, cases.....lb.	.32 - .33	.32 - .34	.32 - .33
Citric, kegs.....lb.	.46 - .47	.46 - .47	.44 - .45	Potassium bichromate, casks, lb.	.084 - .084	.084 - .084	.084 - .084
Formic, bbl.....lb.	.11 - .12	.11 - .12	.10 - .11	Carbonate, 80-85%, calc., cask, lb.	.051 - .06	.051 - .06	.051 - .06
Gallie, tech., bbl.....lb.	.50 - .55	.50 - .55	.50 - .55	Chlorate, powd.....lb.	.08 - .084	.084 - .09	.084 - .09
Hydrofluoric 30% carb.....lb.	.06 - .07	.06 - .07	.06 - .07	Cyanide, cs.....lb.	.51 - .53	.53 - .58	.55 - .57
Lactic, 44%, tech., light, bbl, lb.	.12 - .124	.13 - .14	.134 - .14	First sorts, cask.....lb.	.084 - .09	.084 - .09	.084 - .09
22%, tech., light, bbl, lb.	.044 - .05	.06 - .07	.064 - .07	Hydroxide (c'atic potash) dr, lb.	.072 - .074	.072 - .074	.072 - .074
Muriatic, 18%, tanks.....ewt.	.85 - .90	.85 - .90	.85 - .90	Muriate, 80% bags.....ton	36.40 - .	36.40 - .	36.40 - .
Nitric, 36%, carboys.....lb.	.05 - .051	.05 - .051	.05 - .051	Nitrate, bbl.....lb.	.06 - .064	.06 - .064	.06 - .071
Oleum, tanks, wks.....ton	18.00 - 20.00	18.00 - 20.00	18.00 - 20.00	Nitrate, bulk.....lb.	.15 - .16	.15 - .16	.14 - .15
Oxalic, crystals, bbl.....lb.	.084 - .09	.084 - .09	.084 - .09	Permanaganate, drums.....lb.	.171 - .19	.171 - .19	.181 - .19
Phosphoric, tech., c'by's.....lb.	.11 - .114	.11 - .114	.11 - .114	Prussiate, yellow, cases.....lb.	.047 - .05	.047 - .05	.051 - .06
Sulphuric, 60% tanks.....ton	11.00 - 11.50	11.00 - 11.50	10.50 - 11.00	Sal ammoniac, white, casks.....lb.	.90 - .95	.90 - .95	.90 - .95
Tannic, tech., bbl.....lb.	.35 - .40	.35 - .40	.35 - .40	Salsoda, bbl.....ewt.	14.00 - 17.00	14.00 - 17.00	17.00 - 19.00
Tartaric, powd., bbl.....lb.	.38 - .384	.38 - .384	.33 - .34	Salt cake, bulk.....ton	14.00 - 17.00	14.00 - 17.00	17.00 - 19.00
Tungstic, bbl.....lb.	1.00 - 1.20	1.00 - 1.20	1.00 - 1.20	Soda ash, light, 58%, bags,			
Alcohol, ethyl, 190 n°, bbl, gal.	2.704 - 2.75	2.704 - 2.75	4.924 - 5.00	contract.....ewt.	1.32 - .	1.32 - .	1.32 - .
Alcohol, Butyl, dr.....lb.	.184 - .19	.19 - .20	.194 - .20	Dense, bags.....ewt.	1.35 - .	1.35 - .	1.37 - .
Denatured, 190 proof.....				Soda, caustic, 76%, solid,			
No. 1 special dr.....gal.	.45 - .	.44 - .	.45 - .	drums, contract.....ewt.	2.80 - 3.00	2.80 - 3.00	3.00 - 3.10
No. 5, 188 proof, dr.....gal.	.44 - .	.43 - .	.43 - .	Acetate, works, bbl.....lb.	.051 - .06	.051 - .064	.044 - .05
Alum, ammonia, lump, bbl.....lb.	.031 - .04	.031 - .04	.031 - .04	Bicarbonate, bbl.....ewt.	2.00 - 2.25	2.00 - 2.25	2.00 - 2.25
Chrome, bbl.....lb.	.054 - .055	.054 - .055	.054 - .055	Bichromate, casks.....lb.	.07 - .074	.07 - .074	.061 - .064
Potaab, lump, bbl.....lb.	.022 - .031	.022 - .031	.022 - .031	Bisulphite, bulk.....ton	3.00 - 3.50	5.00 - 5.50	5.00 - 5.50
Aluminum sulphate, com., bags.....ewt.	1.40 - 1.45	1.40 - 1.45	1.40 - 1.45	Bisulphite, bbl.....lb.	.031 - .031	.031 - .04	.031 - .04
Iron free, bg.....ewt.	2.00 - 2.10	2.00 - 2.10	2.00 - 2.10	Chlorate, kegs.....lb.	.051 - .06	.051 - .06	.061 - .064
Aqua ammonia, 26%, drums, lb.	.03 - .04	.03 - .04	.024 - .03	Chloride, tech., ton	12.00 - 14.75	12.00 - 14.75	12.00 - 14.00
Ammonia, anhydrous, cyl.....lb.	.134 - .	.134 - .	.11 - .13	Cyanide, cases, dom.....lb.	.18 - .22	.18 - .22	.18 - .22
Ammonium carbonate, powd., tech., casks.....lb.	.104 - .14	.104 - .14	.104 - .14	Fluoride, bbl.....lb.	.084 - .094	.09 - .094	.094 - .10
Sulphate, wks.....ewt.	2.40 - .	2.70 - .	2.45 - .	Hyposulphite, bbl.....lb.	.250 - 3.00	2.50 - 3.00	2.50 - 3.00
Amylaectate tech., drums.....gal.	1.75 - 2.00	1.75 - 2.00	2.15 - 2.20	Nitrate, bags.....ewt.	2.22 - .	2.35 - .	2.65 - .
Antimony Oxide, bbl.....lb.	.12 - .124	.134 - .15	.161 - .17	Nitrite, cases.....lb.	.074 - .08	.074 - .08	.08 - .084
Arsenic, white, powd., bbl, dr.....lb.	.04 - .044	.04 - .044	.031 - .044	Phosphate, dibasic, bbl.....lb.	.03 - .034	.03 - .034	.031 - .034
Red, powd., kegs.....lb.	.09 - .10	.09 - .10	.104 - .11	Prussiate, yel, drums.....lb.	.11 - .12	.12 - .124	.12 - .124
Barium carbonate, bbl.....ton	57.50 - 60.00	57.50 - 60.00	50.00 - 52.00	Silicate (30°), drums.....ewt.	.75 - 1.15	.75 - 1.15	.75 - 1.15
Chloride, bbl.....ton	55.00 - 58.00	55.00 - 58.00	58.00 - 60.00	Sulphide, fused, 60-62%, dr, lb.	.022 - .034	.022 - .03	.031 - .04
Nitrate, cask.....lb.	.071 - .08	.08 - .084	.071 - .08	Sulphite, crya, bbl.....lb.	.024 - .03	.024 - .03	.024 - .03
Blanc fixe, dry, bbl.....lb.	.034 - .04	.04 - .044	.04 - .044	Strontium nitrate, bbl.....lb.	.09 - .094	.09 - .094	.084 - .09
Bleaching powder, f.o.b., wks., drums.....ewt.	2.00 - 2.10	2.00 - 2.10	2.00 - 2.10	Sulphur, crude at mine, bulk, ton	18.00 - .	18.00 - .	18.00 - .
Borax, bbl.....lb.	.024 - .03	.04 - .044	.041 - .044	Chloride, dr.....lb.	.04 - .05	.04 - .05	.05 - .054
Bromine, cs.....lb.	.45 - .47	.45 - .47	.45 - .47	Dioxide, cyl.....lb.	.09 - .10	.09 - .10	.09 - .10
Calcium acetate, bags.....ewt.	.350 - .	.350 - .	.350 - .	Flour, bag.....ewt.	2.70 - 3.00	2.70 - 3.00	2.70 - 3.00
Arsenate, dr.....lb.	.061 - .07	.061 - .07	.071 - .074	Tin bichloride, bbl.....lb.	.15 - .	.15 - .	.19 - .
Carbide drums.....lb.	.05 - .06	.05 - .06	.05 - .06	Oxide, bbl.....lb.	.56 - .	.56 - .	.69 - .
Chloride, fused, dr, wks, ton	20.00 - .	20.00 - .	21.00 - .	Crystals, bbl.....lb.	.371 - .	.371 - .	.47 - .
Phosphate, bbl.....lb.	.07 - .074	.07 - .074	.07 - .074	Zinc chloride, gran., bbl.....lb.	.061 - .064	.061 - .064	.061 - .064
Cobalt bisulphide, drums.....lb.	.05 - .06	.054 - .06	.054 - .06	Carbonate, bbl.....lb.	.10 - .11	.10 - .104	.104 - .11
Tetrachloride drums.....lb.	.061 - .07	.061 - .07	.061 - .07	Cyanide, dr.....lb.	.40 - .41	.40 - .41	.40 - .41
Chlorine, liquid, tanks, wks., cylinders.....lb.	.034 - .044	.034 - .044	.04 - .044	Dust, bbl.....lb.	.084 - .09	.09 - .10	.10 - .11
Cobalt oxide, cans.....lb.	.210 - 2.20	2.10 - 2.20	2.10 - 2.25	Zinc oxide, lead free, bag, lb.	.061 - .	.061 - .	.061 - .
Copperas, bgs., f.o.b., wka, ton	16.00 - 17.00	16.00 - 17.00	14.00 - 17.00	5% lead sulphate, bags.....lb.	.061 - .	.061 - .	.061 - .
Copper carbonate, bbl.....lb.	.161 - .171	.161 - .171	.17 - .18	Sulphate, bbl.....ewt.	2.75 - 3.00	2.75 - 3.00	2.00 - 3.10
Cyanide, tech., bbl.....lb.	.49 - .50	.49 - .50	.49 - .50				
Sulphate, bbl.....ewt.	.530 - 5.50	5.15 - 5.25	4.95 - 5.05				
Cream of tartar, bbl.....lb.	.264 - .27	.252 - .26	.22 - .23				
Diethylene glycol, dr.....lb.	.10 - .15	.10 - .15	.10 - .15				
Epsom salt, dom., tech., bbl, ewt.	1.75 - 2.15	1.75 - 2.00	1.75 - 2.00				
Imp., tech., bags.....ewt.	1.15 - 1.25	1.15 - 1.25	1.35 - 1.40				
Ethyl acetate, 85% drums, gal.	.74 - .76	.74 - .76	.74 - .76				
Formaldehyde, 40%, bbl.....lb.	.071 - .081	.081 - .111	.111 - .111				
Furfural, dr.....lb.	.15 - .171	.15 - .171	.15 - .17				
Fusel oil, crude, drums.....gal.	1.30 - 1.40	1.30 - 1.40	1.40 - 1.50				
Refined, dr.....gal.	2.50 - 3.00	2.50 - 3.00	2.50 - 3.00				
Glauber's salt, bags.....ewt.	1.10 - 1.20	1.00 - 1.10	1.00 - 1.10				
Glycerine, e.p., drums, extra, lb.	.15 - .151	.15 - .151	.25 - .26				
Lead: White, basic carbonate, dry, cases.....lb.	.084 - .	.084 - .	.094 - .				
White, basic sulphate, sek, lb.	.074 - .	.074 - .	.092 - .				
Red, dry, sek, lb.	.094 - .	.094 - .	.10 - .				
Lead acetate, white crys, bbl, lb.	.13 - .134	.13 - .134	.144 - .				
Lead arsenate, powd., bbl, lb.	.13 - .14	.12 - .13	.14 - .15				
Lime, chem., bulk.....ton	8.50 - .	8.50 - .	8.50 - .				
Litharge, p.wd., cask.....lb.	.084 - .	.084 - .	.10 - .				
Lithopone, bags.....lb.	.054 - .06	.054 - .06	.054 - .06				
Magnesium carb, tech., bags, lb.	.061 - .07	.078 - .08	.078 - .08				
Methanol, 95%, dr.....gal.	.43 - .45	.43 - .45	.66 - .85				
97%, dr.....gal.	.45 - .47	.45 - .47	.68 - .87				
Nickel salt, double, bbl.....lb.	.10 - .104	.10 - .104	.10 - .10				
Single, bbl.....lb.	.104 - .11	.104 - .11	.104 - .114				

## Coal-Tar Products

	Current Price	Last Month	Last Year
Alpha-naphthol, crude, bbl, lb.	\$0.60 - \$0.65	\$0.60 - \$0.65	\$0.60 - \$0.62
Refined, bbl.....lb.	.85 - .90	.85 - .90	.85 - .90
Alpha-naphthylamine, bbl, lb.	.35 - .36	.35 - .36	.35 - .36
Aniline oil, drums, extra.....lb.	.15 - .16	.15 - .16	.15 - .16
Aniline salts, bbl.....lb.	.24 - .25	.24 - .25	.24 - .25
Anthracene, 80%, drums.....lb.	.60 - .65	.60 - .65	.60 - .65

## Coal Tar Products (Continued)

	Current Price	Last Month	Last Year
Benzaldehyde, U.S.P., dr.	1.15 - 1.25	1.15 - 1.35	1.15 - 1.25
Bensidine base, bbl.	.70 - .72	.70 - .75	.70 - .72
Benzoin acid, U.S.P., kgs.	.58 - .60	.58 - .60	.58 - .60
Benyl chloride, tech, dr.	.25 - .26	.25 - .26	.23 - .24
Benzol, 90%, tanks, works, gal.	.22 - .23	.21 - .22	.24 - .25
Beta-naphthol, tech, drums, lb.	.22 - .24	.22 - .24	.22 - .24
Cresol, U.S.P., dr.	.18 - .20	.18 - .20	.18 - .20
Cresylic acid, 97%, dr., wks, gal.	.73 - .75	.73 - .75	.61 - .62
Diethylamine, dr.	.58 - .60	.58 - .60	.58 - .60
Dinitrophenol, bbl.	.31 - .35	.31 - .33	.31 - .35
Dinitrotoluene, bbl.	.17 - .18	.17 - .18	.17 - .18
Dip oil, 25% dr.	.28 - .30	.28 - .30	.28 - .30
Diphenylamine, bbl.	.45 - .47	.45 - .47	.45 - .47
H-acid, bbl.	.63 - .65	.63 - .65	.63 - .65
Naphthalene, flake, bbl.	.05 - .06	.041 - .05	.051 - .06
Nitrobenzene, dr.	.081 - .10	.09 - .10	.09 - .10
Para-nitramiline, bbl.	.52 - .53	.52 - .53	.50 - .53
Para-nitrotoluene, bbl.	.28 - .32	.28 - .32	.40 - .42
Phenol, U.S.P., drums.	.15 - .17	.17 - .18	.17 - .18
Pieric acid, bbl.	.30 - .40	.30 - .40	.25 - .26
Pyridine, dr.	3.00 -	3.00 -	3.90 - 4.00
R-salt, bbl.	.47 - .50	.47 - .50	.47 - .50
Resorcinol, tech, kgs.	1.30 - 1.35	1.35 - 1.40	1.30 - 1.40
Salicylic acid, tech., bbl.	.30 - .32	.30 - .32	.30 - .32
Solvent naphtha, w.w., tanks, gal.	.35 -	.35 -	.35 -
Tolidine, bbl.	.95 - .95	.95 - .96	.90 - .95
Toluene, tanks, works.	.35 -	.35 -	.35 -
Xylene, com., tanks	.36 - .41	.36 - .41	.36 - .40

## Miscellaneous

	Current Price	Last Month	Last Year
Barytes, grd., white, bbl.	\$23.00 - \$25.00	\$23.00 - \$25.00	\$23.00 - \$25.00
Casein, tech, bbl.	.151 - .16	.16 - .18	.15 - .16
China clay, dom., f.o.b. mine ton	10.00 - 20.00	10.00 - 20.00	10.00 - 20.00
Dry colors:			
Carbon gas, black (wks.)	.061 - .07	.061 - .07	.08 - .081
Prussian blue, bbl.	.31 - .33	.31 - .33	.33 - .34
Ultramine blue, bbl.	.08 - .35	.08 - .35	.08 - .35
Chrome green, bbl.	.27 - .31	.27 - .30	.27 - .30
Carmine red, tina.	.525 - .550	.550 - .575	.500 - .510
Para toner.	.60 - .70	.70 - .80	.80 - .90
Vermilion, English, bbl.	1.80 - 1.85	1.80 - 1.85	1.45 - 1.50
Chrome yellow, C. P., bbl.	.151 - .16	.17 - .18	.171 - .18
Feldspar, No. 1 (f.o.b. N. C.)	5.75 - 7.00	5.75 - 7.00	5.75 - 7.00
Graphite, Ceylon, lump, bbl.	.08 - .081	.071 - .091	.08 - .09
Gum copal, Congo, bags.	.071 - .08	.071 - .08	.091 - .10
Manila, bags.	.15 - .18	.15 - .16	.15 - .18
Damar, Batavia, cases.	.22 - .23	.23 - .24	.25 - .25
Kauri, No. 1 cases.	.48 - .53	.48 - .53	.55 - .57
Kieselguhr (f.o.b. N. Y.)	50.00 - 55.00	50.00 - 55.00	50.00 - 55.00
Magnesite, calc.	40.00 -	44.00 -	44.00 -
Pumice stone, lump, bbl.	.05 - .07	.05 - .08	.05 - .07
Imported, casks.	.03 - .40	.03 - .40	.03 - .35
Rosin, H.	9.00 -	9.90 -	10.85 -
Turpentine.	.531 -	.58 -	.62 -
Shellac, orange, fine, bags.	.52 -	.51 - .52	.52 - .53
Bleached, bonedry, bags.	.54 - .56	.54 - .56	.59 - .61
T. N. bags.	.45 - .46	.45 - .46	.40 - .45
Soapstone (f.o.b. Vt.), bags, ton	10.00 - 12.00	10.00 - 12.00	10.00 - 12.00
Talc, 200 mesh (f.o.b. Vt.), ton	9.50 -	10.50 -	11.00 -
300 mesh (f.o.b. Ga.)	7.50 - 10.00	7.50 - 10.00	7.50 - 11.00
225 mesh (f.o.b. N. Y.)	13.75 -	13.75 -	14.75 -

	Current Price	Last Month	Last Year
Wax, Bayberry, bbl.	\$0.33 - \$0.34	\$0.32 - \$0.33	\$0.25 - \$0.26
Bee蜡, rel., light.	.41 - .42	.43 - .47	.45 - .46
Candelilla, bags.	.24 - .25	.25 - .27	.33 - .34
Carnauba, No. 1, bags.	.55 - .56	.54 - .55	.65 - .70
Paraffine, crude	105-110 m.p.	.041 - .05	.051 - .06

## Ferro-Alloys

	Current Price	Last Month	Last Year
Ferrotitanium, 15-18%	\$200.00 -	\$200.00 -	\$200.00 -
Ferromanganese, 75-82%	105.00 -	100.00 -	100.00 - 90.00
Spiegeleisen, 19-21%	32.00 -	31.00 - 32.00	36.00 - 37.00
Ferrosilicon, 14-17%	45.00 -	44.50 -	-
Ferrotungsten, 70-80%	.95 - .98	.92 - .95	.98 - 1.05
Ferro-uranium, 35-50%	4.50 -	4.50 -	4.50 -
Ferrovandium, 30-40%	3.15 - 3.75	3.15 - 3.75	3.15 - 3.75

## Non-Ferrous Metals

	Current Price	Last Month	Last Year
Copper, electrolytic.	lb. \$0.141 -	lb. \$0.141 -	lb. \$0.138 -
Aluminum, 96-99%	lb. .24 - .26	lb. .24 - .26	lb. .26 - .28
Antimony, Chin. and Jap.	lb. .104 -	lb. .11 -	lb. .12 -
Nickel, 99%	lb. .5 -	lb. .33 -	lb. .35 -
Monel metal, blocks.	lb. .28 -	lb. .32 - .33	lb. .32 - .33
Tin, 5-ton lots, Straits.	lb. .481 -	lb. .52 -	lb. .671 -
Lead, New York, spot.	lb. 6.30 -	lb. 6.10 -	lb. 6.40 -
Zinc, New York, spot.	lb. 6.50 -	lb. 6.35 -	lb. 6.57 -
Silver, commercial.	oz. .571 -	lb. .571 -	lb. .571 -
Cadmium.	lb. .60 -	lb. .60 -	lb. .60 -
Bismuth, ton lots.	lb. 1.85 - 2.10	lb. 1.85 - 2.00	lb. 2.20 - 2.25
Cobalt.	lb. 2.50 -	lb. 2.50 -	lb. 2.50 -
Magnesium, ingots, 99%	lb. .98 -	lb. .75 - .80	lb. .75 - .80
Platinum, ref.	oz. 75.50 - 76.50	oz. 85.00 -	oz. 108.00 -
Palladium, ref.	oz. 46.00 - 49.00	oz. 50.00 - 52.00	oz. 59.00 - 63.00
Mercury, flask.	75 lb. 123.00 -	75 lb. 124.50 -	75 lb. 126.00 -
Tunesten powder.	lb. 1.05 - 1.151	lb. 1.05 -	lb. 05 -

## Ores and Semi-finished Products

	Current Price	Last Month	Last Year
Bauxite, crushed, wks.	ton \$7.50 - \$8.50	ton \$5.50 - \$8.50	ton \$5.50 - \$8.75
Chrome ore, e.f. post.	ton 22.00 - 24.00	ton 22.00 - 24.00	ton 22.00 - 23.00
Coke, fdry, f.o.b. ovens.	ton 2.85 - 3.00	ton 2.85 - 3.00	ton 3.25 - 3.75
Fluorspar, gravel, f.o.b. Ill.	ton 16.00 -	ton 14.50 -	ton 18.00 -
Ilmenite, 52% TiO <sub>2</sub> , Va.	lb. .001 - .001	lb. .001 - .001	lb. .001 - .001
Manganese ore, 50% Mn,	c.i.f. Atlantic Ports	unit .36 - .38	unit .36 - .38
Molybdenite, 85% MoS <sub>2</sub> per	lb. MoS <sub>2</sub> , N. Y.	lb. .48 - .50	lb. .48 - .50
Monazite, 6% of ThO <sub>2</sub> .	ton 130.00 -	ton 120.00 -	ton 120.00 -
Pyrites, Span. fines, c.i.f.	unit .13 -	unit .134 -	unit .134 -
Rutile, 94-96% TiO <sub>2</sub> .	lb. .11 - .13	lb. .11 - .13	lb. .11 - .13
Tungsten, scheelite,	60% WO <sub>3</sub> and over.	unit 10.50 - 10.75	unit 11.25 - 11.50
Vanadium ore, per lb. V <sub>2</sub> O <sub>5</sub> .	lb. nom.	lb. .25 - .30	lb. .25 - .28
Zircon, 99%	lb. .03 -	lb. .03 -	lb. .03 -

CURRENT INDUSTRIAL DEVELOPMENTS  
New Construction and Machinery Requirements

**Ammonia Distribution Plant**—Robinson Bros. Buffalo Ammonia Co., M. Metzner, 225 Randolph St., Brooklyn, N. Y., awarded contract for a 1 story ammonia distribution plant at Randolph St. and Scott Ave. to H. Veit, 260 Devoe St., Brooklyn, N. Y. Estimated cost \$50,000.

**Benzol Plant**—Lake Superior Corp., 503 Queen St. E., Sault Ste Marie, Ont., plans the construction of a benzol plant. Estimated cost \$200,000. Complete equipment will be required.

**Brass Foundry**—Barbour-Stockwell Co., 205 Broadway, Cambridge, Mass., awarded contract for a 1 story brass foundry at Broadway and Market St. to W. Fillmore Co., Cherry St., Cambridge, Mass.

**Brewery**—Border Brewers Ltd., Amherstburg, Ont., is having plans prepared for a brewery on William St. Estimated cost \$250,000. Machinery and equipment will be required. W. Furlong, Amherstburg, Ont., is interested.

**Candy Factory**—Brown Candy & Cracker Co., 810 South Medina St., San Antonio, Tex., will soon receive bids for the construction of a 4 story, 144 x 218 ft. candy factory at El Paso and Medina Sts. Estimated cost \$350,000. Private plans. Machinery and equipment will be required.

**Canning Factory**—Ocean Spray Canning Co., Onset, Mass., awarded contract for a cannery plant, three units, 1 story, 55 x 80 ft., 2 story, 36 x 56 ft. and 3 story, 40 x 240 ft. to Z. A. Jenkins, Onset, Mass.

**Carborundum Factory**—Carborundum Co., Niagara Falls, N. Y., will soon award contract for a 5 story, 81 x 224 ft. carbor-

undum factory. L. J. Call, Niagara Falls, N. Y., is engineer.

**Cement Plant**—F. R. Drew, McAlster, Oklahoma, Robert W. Hunt Co., 303 Orear Leslie Bldg., Kansas City, Mo. and Leigh Hunt, New York, N. Y., plan the construction of a cement plant, 4,000 bbl. daily capacity in Kentucky (location not decided). Estimated cost \$1,750,000.

**Cement Plant**—Smith Bros. Properties Inc., c/o J. W. Young, V. Pres., Plaza Hotel, San Antonio, Tex., is having plans prepared for the construction of a cement plant. Estimated cost \$2,000,000. Terrell Bartlett, Engrs. c/o Calcasieu Bldg., San Antonio, Tex., are engineers. Machinery and equipment will be required.

**Cement Foundry**—F. L. Smith & Co., 50 Church St., New York, N. Y., will soon award contract for a 1 story, 20 x 50 ft. cement foundry at Elizabeth, N. J. Estimated cost \$40,000. Private plans.

**Chemical Factory**—Plough Chemical Co., A. Plough, Pres., 121 South Second St., Memphis, Tenn., plans the construction of a chemical factory at Parkway opposite Tri-State Fair. Estimated cost \$750,000. Hunker & Cairns, 123 South Court St., Memphis, Tenn., are architects.

**Chlorine**—G. M. Atkinson, Clk., St. Cloud, Minn., will receive bids until June 26 for 3,600 lbs. of liquid chlorine for Dept. of Waterworks.

**Cocoa Factory**—Reichardt Cocoa & Chocolate Co., Jersey Ave., New Brunswick, N. J., will soon award contract for a 3 story, 60 x 200 ft. cocoa factory on Jersey Ave. Estimated cost \$100,000. R. G. Cory,

30 Church St., New York, N. Y., is architect and engineer.

**Coke Ovens and Gas Holder**—Central Alloy Steel Corp., 8th St. N.E., Canton, O., will soon receive bids for the construction of fifteen coke ovens and a 5,000,000 cu. ft. gas holder. Estimated cost \$600,000.

**Explosive Plant**—Canadian Industries Ltd., A. B. Purvis, Pres., Canada Cement Bldg., Montreal, Que., plans the construction of an explosive plant at Winnipeg, Man. Estimated cost \$1,000,000.

**Fertilizer Plant**—American Agricultural Chemical Co., Lexington Bldg., Baltimore, Md., awarded contract for the construction of a 3 story, 169 x 201 ft. chemical factory including laboratory, storage and manufacturing buildings, etc. at First St. and Tenth Ave., Canton, Md. to Consolidated Engineering Co., 20 East Frank St., Baltimore, Md. Estimated cost \$200,000.

**Gas Plant**—A. I. Phillips, 122 Greenwich St., New York, N. Y., will build a gas plant by day labor at Greenwood, S. C. Estimated cost \$100,000.

**Gas Plant Extensions**—Southwest Gas Utilities Corp., Ada, Okla., has acquired 32 natural gas systems in Texas, Oklahoma and Louisiana and plans extensions and improvements. Estimated cost \$1,000,000. Private plans.

**Gas By-Products House**—Brooklyn Union Gas Co., 176 Remsen St., Brooklyn, N. Y., awarded contract for a gas products house at Gardner and Maspeth Aves. to Bartlett-Haywood Co., 200 Scott St., Baltimore, Md. Estimated cost \$500,000.

**Gas Plant**—North Alabama Utilities Co., Sheffield, Ala., is having surveys made for the construction of a gas plant. Estimated cost \$100,000.

**Glass Plant**—Illinois Pacific Glass Co., 15th and Folsom Sts., San Francisco, Calif., awarded contract for the construction of a glass factory at Vernon, Calif., to W. P. McNeil Co., 4814 Loma Vista Ave., Los Angeles, Calif. Estimated cost \$400,000.

**Glass Plant**—Libby Owens Sheet Glass Co., Nicholas Bldg., Toledo, O., plans the construction of a glass plant. Estimated cost \$1,000,000. Lockwood, Greene & Co., Hanna Bldg., Cleveland, O., are engineers.

**Glass Factory**—Southern California Glass Co., 625 East 9th St., Los Angeles, Calif., plans the construction of a glass factory at 945 Birch St. Estimated cost \$40,000. C. A. Elliot, 328 Union Insurance Bldg., Los Angeles, Calif., is architect.

**Glove Factory**—C. T. Houghton & Co., 116 West 3rd St., Cincinnati, O., is having preliminary plans prepared for the construction of a glove factory at Carbondale, Ill. Estimated cost \$50,000.

**Gypsum Plant**—U. S. Gypsum Co., S. L. Avery, Pres., 300 West Adams St., Chicago, Ill., plans the construction of a gypsum plant at Philadelphia, Pa. J. H. Nold, 300 West Adams St., Chicago, Ill., is engineer.

**Ink Ribbon Factory**—Direct Ink Ribbon Corp., 32 North 5th St., Camden, N. J., awarded contract for a 2 story, 50 x 175 ft. ink ribbon factory at 20th and Federal Sts. to Graham Chambley Co., 3649 Filbert St., Philadelphia, Pa. Estimated cost \$60,000.

**Kalsomine Factory**—Westcoast Kalsomine Co., 60 Federal St., San Francisco, Calif., is having plans prepared for a 1 story, 100 x 120 ft. kalsomine factory at Good Hope, La. Estimated cost \$50,000. Private plans.

**Laboratory**—Commission of City Property, City Hall, New Bedford, Mass., will soon award contract for the construction of a vocational school including laboratory, etc. C. Hammond & Son, 179 North Water St., New Bedford, Mass., are architects.

**Laboratory**—The Hensen Co., c/o C. Haug & Son, Burrell Bldg., Little Falls, N. Y., had plans prepared for the construction of a 1 story laboratory. Estimated cost \$300,000.

**Laboratory**—R. T. Vanderbilt Co., W. H. Cope, 50 East 42nd St., New York, N. Y., will soon award contract for a 3 story, 50 x 80 ft. laboratory on Winnfield St., East Norwalk St. Estimated cost \$55,000. H. T. Lindeberg, 2 West 47th St., New York, N. Y., is architect.

**Laboratory, Etc.**—Methodist Hospital, 16th and Capitol Sts., Indianapolis, Ind., awarded contract for a 4 story hospital including laboratory, etc. Estimated cost \$200,000. D. A. Bohlen & Son, Majestic Bldg., Indianapolis, Ind., are architects.

**Laboratory (Chemistry)**—Case School of Applied Science, C. S. Howe, Pres., Euclid Ave. and Wade Park, Cleveland, O., is having preliminary plans prepared for a 4 story, 50 x 220 ft. chemistry laboratory. Estimated cost \$800,000. Wilbur Watson & Associates, 4614 Prospect Ave., Cleveland, O., are architects.

**Laboratory (Research)**—General Motors Corp., General Motors Bldg., Detroit, Mich., will soon award contract for an 11 story, 210 x 225 ft. research laboratory on Second Ave. Estimated cost \$1,000,000.

**Laboratories**—Bd. of Education, Pomona, Calif., is having preliminary plans prepared for the construction of a high school including laboratories, etc. Estimated cost \$240,000. T. C. Kistner & Co., 814 Architects Bldg., Los Angeles, Calif., are architects.

**Leather and Belting Equipment**—Lang Leather & Belting Co., J. H. Lang, Gen. Mgr., Ashley and Cannon Sts., Hamilton, Ont., plans the installation of complete equipment for the manufacture of leather and belting, accessories and tanning for recently acquired plant. Estimated cost \$100,000.

**Milk Condensery**—Wetumka Cream Co., Wetumka, Okla., is having preliminary plans prepared for a milk condensery. Estimated cost \$40,000. Private plans.

**Oxygen and Hydrogen Plant**—Linde Air Products Co., subsidiary of the Union Carbide & Carbon Co., 30 East 42nd St., New York, N. Y., awarded contract for a 1 story plant for the manufacture of oxygen and hydrogen and other tank gases at Canton, O. Estimated cost \$40,000.

**Paint Factory**—Benjamin Moore & Co., 134 Lester Ave., Newark, N. J., awarded contract for a 2 story, 92 x 150 ft. paint factory, etc. to J. W. Ferguson Co., 152 Market St., Paterson, N. J. Estimated cost \$60,000.

**Paint Factory**—United Paint & Varnish Co., Times Bldg., New York, N. Y., awarded contract for a 1 story, 100 x 100 ft. paint factory at foot of 39th St., North Bergen, N. J., to Bonanno Bros., 1827 Bergen Turnpike, North Bergen, N. J. Estimated cost \$75,000.

**Paint and Varnish Factory**—George & Oldfield Inc., Los Angeles, Calif., awarded contract for a 1 story, 50 x 100 ft. paint and varnish factory to The Austin Co. of California, 777 East Washington St. Estimated cost \$50,000.

**Paper Mill**—A. L. Adams Paper Co., Baldwinsville, Mass., had plans prepared for a 2 story, 80 x 200 ft. paper mill. Estimated cost \$100,000. L. Shilick, 314 Beacon St., Boston, Mass., is architect.

**Paper Mill**—A. L. Adams Paper Co., Baldwinsville, Mass., is having plans prepared for a 2 story, 80 x 100 ft. paper mill. L. Shilick, 314 Beacon St., Boston, Mass., is engineer.

**Paper Mill Addition**—Appleton Paper Co., Appleton, Wis., plans a 1 story, 107 x 240 ft. addition to paper mill. Lockwood, Greene & Co., 400 North Michigan Ave., Chicago, Ill., are engineers.

**Paper Mill**—Backus Brooks Co., 1100 Builders Exchange Bldg., Minneapolis, Minn., plans the construction of a 100,000 ton paper mill at Fort William, Ont.

**Photoproducts Factory**—Afga Anasco Mfg. Co., H. W. Davis, Pres., 23 Charles St., Binghamton, N. Y., awarded contract for the construction of a photoproducts factory including laboratories, etc. to Turner Construction Co., 11 Goodell St., Buffalo, N. Y. Estimated cost \$600,000.

**Pulp and Paper Mill**—West Virginia Pulp & Paper Co., 200 5th Ave., New York, N. Y., awarded contract for extensions and additions to pulp and paper mill at Mechanicsville, N. Y., to Morton C. Tuttle Co., 31 St. James Ave., Boston, Mass. Estimated cost \$500,000.

**Pyrofax Plant**—Union Carbide & Carbon Co., 30 East 42nd St., New York, N. Y., awarded contract for a 1 story pyrofax plant at Cambridge, Mass. to The Scully Co., 238 Main St., Cambridge, Mass. Estimated cost \$40,000.

**Raw Felt Factory**—Certainteed Products Co., Anderson, Ind., have acquired the plant of the Beaver Products Co. and plans to remodel fourteen building at Anderson, Ind., for manufacture of raw felt for roofing. Estimated cost \$40,000. Machinery and equipment will be required. W. R. Cady, is local manager.

**Rayon Mill**—American Chatillon Corp., 393 7th Ave., New York, N. Y., is having plans prepared for the construction of a rayon mill on the Oostanaula River. Estimated cost \$4,000,000. Lockwood-Green Inc., 1 Pershing Sq., New York, N. Y., are engineers.

**Rayon Factory**—Delaware Rayon Co., c/o F. L. Leary, Rep., Chamber of Commerce, New Bedford, Mass. plans the construction of a rayon mill. Estimated cost \$250,000. Architect not selected.

**Refinery (Electrolytic Copper)**—Nichols Copper Co., 25 Broad St., New York, N. Y., subsidiary of Phelps Dodge Corp., 99 John St., New York, will build an electrolytic copper refinery, 100,000 ton annual capacity at El Paso, Tex. Estimated cost \$3,000,000. Work will be done by day labor.

**Refinery (Gasoline)**—Phillips Petroleum Co., Bartlesville, Okla., plans the construction of a gasoline refinery 20,000 gal. daily capacity on Rock Creek in Hutchinson County, Tex. Estimated cost \$150,000. Private plans. Work will be done by company forces.

**Refinery (Gasoline and Lubricating Oil)**—Cautemoc Refining Co., B. Laurel, Laredo, Tex., will build a gasoline and lubricating oil refinery 1500 bbl. capacity at Nuevo Laredo, Mexico. Estimated cost \$100,000. Equipment will be required.

**Refinery (Oil)**—Burford Oil Co., c/o J. J. Thomas, Pecos, Tex., awarded contract for the construction of an oil refinery, 5000 bbl. capacity to Graver Corp., 4809 Todd Ave., Chicago, Ill. Estimated cost \$650,000.

**Refinery (Oil)**—Prudential Refinery Corp., Baltimore, Md., is having plans prepared for the construction of an oil refinery at Fairfield (Sta. Baltimore) Md. Estimated cost including equipment \$2,000,000.

**Refinery (Oil and Gas)**—Golden West Oil Co., Hondo, Tex., will build an oil and gas refinery in Ina fields in Medina County near D'Hanis, Tex. Estimated cost \$75,000. Private plans. Asphalt taken from oil will be marketed.

**Rubber Factory** (Boston P. O.)—Hartz-Mason Rubber Mfg. Co., 270 Pleasant St., Watertown, Mass., awarded contract for a 1 story, 80 x 150 ft. rubber plant to P. T. McMahon, 1081 Washington St., West Newton, Mass. Estimated cost \$40,000.

**Rubber Factory**—Seiberling Rubber Co., Barberton, O., will soon receive bids for construction of a 2 story rubber factory on West Barberton St. Estimated cost \$110,000.

**Salt Plant Addition**—Canadian Salt Co., Sandwich St. W., Sandwich, Ont., will build a 1 and 2 story addition to salt plant by day labor. Estimated cost \$300,000. Private plans.

**Silk Mill**—A. Schottland Inc., 51 Madison Ave., Paterson, N. J., awarded contract for a 1 story silk mill at Grace and Paul Sts. and Nashville Rd., Rocky Mount, N. C. to D. J. Rose & Sons, Rocky Mount, N. C. Estimated cost \$75,000.

**Soap Factory**—Procter & Gamble Co., Gwynne Bldg., Cincinnati, O., is having plans prepared for the construction of a soap factory at Locust Point, Baltimore, Md. Estimated cost \$3,500,000. H. Manley, 550 East 53rd St., New York, N. Y., is architect.

**Steel Mill Addition**—Weirton Steel Co., Weirton, W. Va., will soon receive bids for addition to steel mill including furnaces, new strip building, new soaking pit building, etc. Estimated cost \$1,350,000.

**Straw Storage Plant**—Homer Laughlin China Co., Newell, plans the construction of a 1 story, 80 x 152 ft. straw storage plant. Estimated cost \$40,000. Private plans.

**Sugar Cane Mill**—Pipes & Krumbhaar, Houma, La., awarded contract for the construction of a sugar cane mill, 2000 ton daily capacity, 12 roller tandem all steel cane carrier with double crusher, steam engine drive.

**Tile Factory**—American Encaustic Tiling Co., 16 East 41st St., New York, N. Y., awarded contracts for a 1 and 2 story, 90 x 640 ft. factory at Maurer, N. J., also 1 story, 100 x 150 ft. factory at Zanesville, O. to The Austin Co., 120 Broadway, New York, N. Y. Estimated cost \$125,000 and \$400,000 respectively.

**Tire Factory**—Suspended Air Tires Ltd., 1189 Bathurst St., Toronto, Ont., plans the construction of a 1 or 2 story, 100 x 100 ft. tire factory on Atherly Rd. Estimated cost \$100,000. Architect and engineer not selected.

**Tobacco By-Products & Chemical Factory**—Tobacco By-Products & Chemical Corp., Columbia Bldg., Louisville, Ky., awarded contract for the construction of a 60 x 360 ft. factory including 40 x 80 ft. machine shop, 49 x 52 ft. power house, etc. at 17th and Magnolia Sts. to L. W. Hancock & Co., Louisville Trust Bldg., Louisville, Ky. Estimated cost \$500,000.

**Waterproofing Factory**—Anti Hydro Waterproofing Co., 265 Badger Ave., Newark, N. J., awarded contract for a 3 story, 60 x 100 ft. waterproofing factory to Shore Construction Co., 94 Christie St., Newark, N. J. Estimated cost \$60,000.

**Wax Paper Factory**—Waxide Paper Co., Berkowitz Ave., 20th and Tracy Sts., Kansas City, Mo., awarded contract for a 1 story, 150 x 267 ft. wax paper factory at Newstead St. between Hunt and Race Sts. St. Louis, Mo., to Fruin-Colnon Contracting Co., 501 Merchants Laclede Bldg., St. Louis, Mo. Estimated cost \$250,000.

**Zinc Concentrating Plant**—St. Louis Smelting & Refining Co., Miami, Okla., is having preliminary plans prepared for the construction of a 500 ton zinc concentrating plant near Miami, Okla. Estimated cost \$60,000. Private plans.

**Zinc and Chemical Factory**—American Zinc & Chemical Co., Clark Bldg., Pittsburgh, awarded contract for a 1 and 2 story addition to zinc and chemical factory at Langloch, Pa. to Rust Engineering Co., American State Bank Bldg., Pittsburgh, Pa. Estimated cost \$400,000.